

VISION STEREOSCOPIQUE ET STRUCTURE TRI-DIMENSIONNELLE DES OBJETS

Guy A. Orban

Chaire européenne 2006-2007

Cours 6

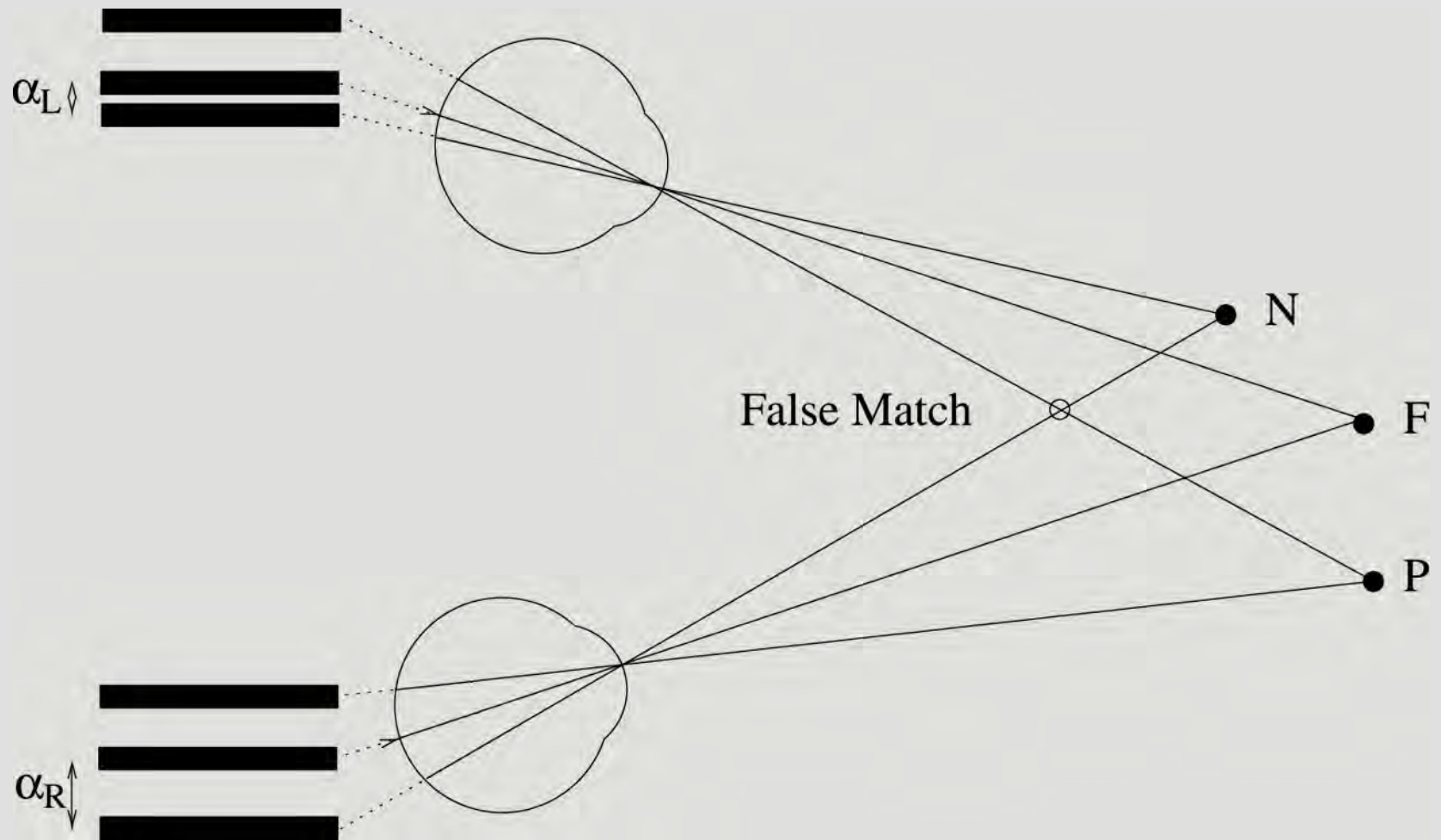


COLLÈGE
DE FRANCE
— 1530 —

KATHOLIEKE UNIVERSITEIT
LEUVEN

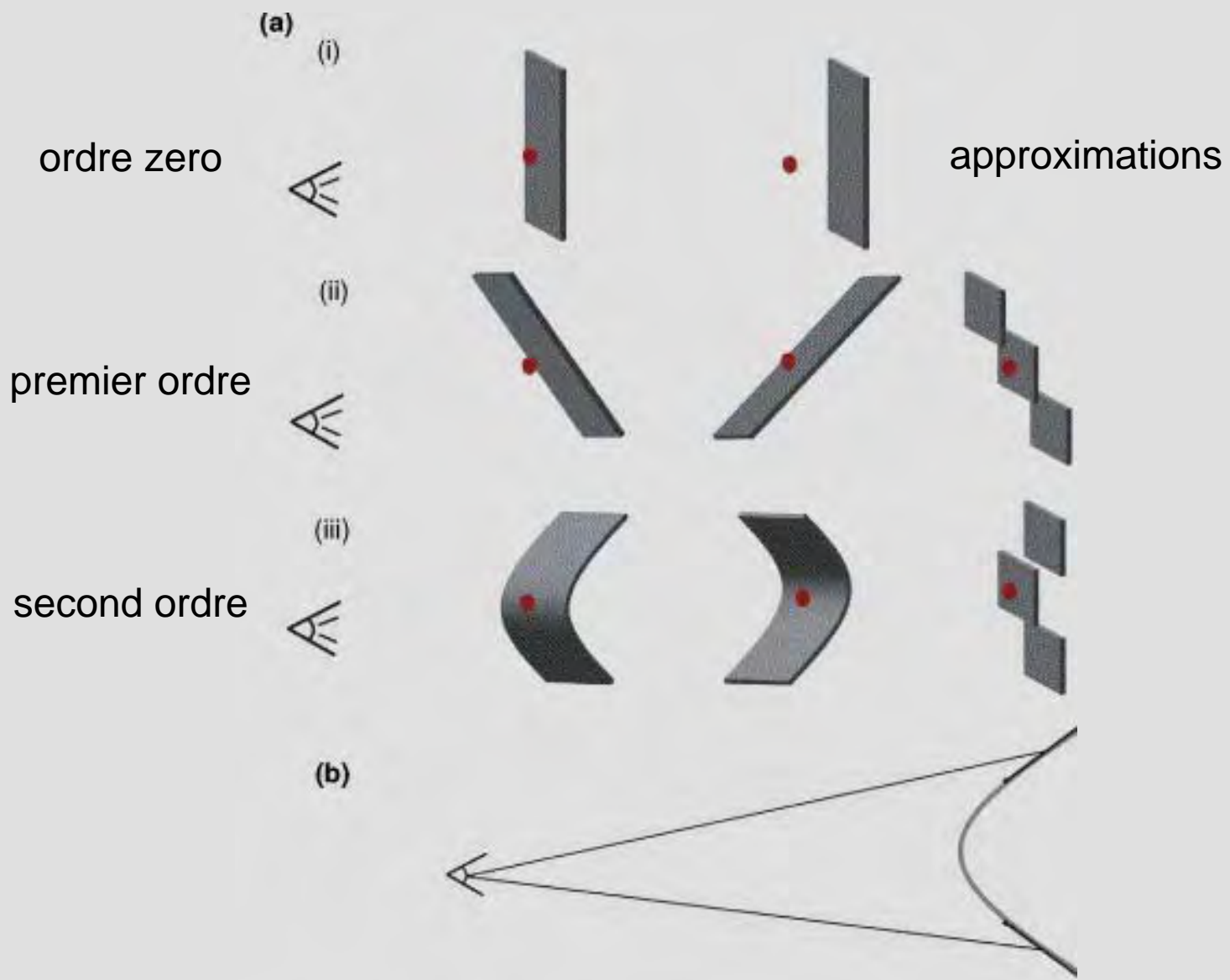


DEFINITION DE LA DISPARITE HORIZONTALE: $DISPARITE = \alpha_L - \alpha_R$



Geometry of binocular vision. Both eyes fixate bar F, so the image of F falls on the fovea in each eye. The images of a nearer bar, N, fall on noncorresponding retinal locations. The angular distances from the fovea (a convenient reference, defining corresponding locations) are marked by α_L and α_R , and the difference between these angles is the binocular disparity of N. This also illustrates the correspondence problem: The image of N in the right eye combined with the image of P in the left eye forms a binocular image with a disparity corresponding to the open circle labeled "false match." No object is perceived at this depth because the brain matches only correctly corresponding features on the two retinae.

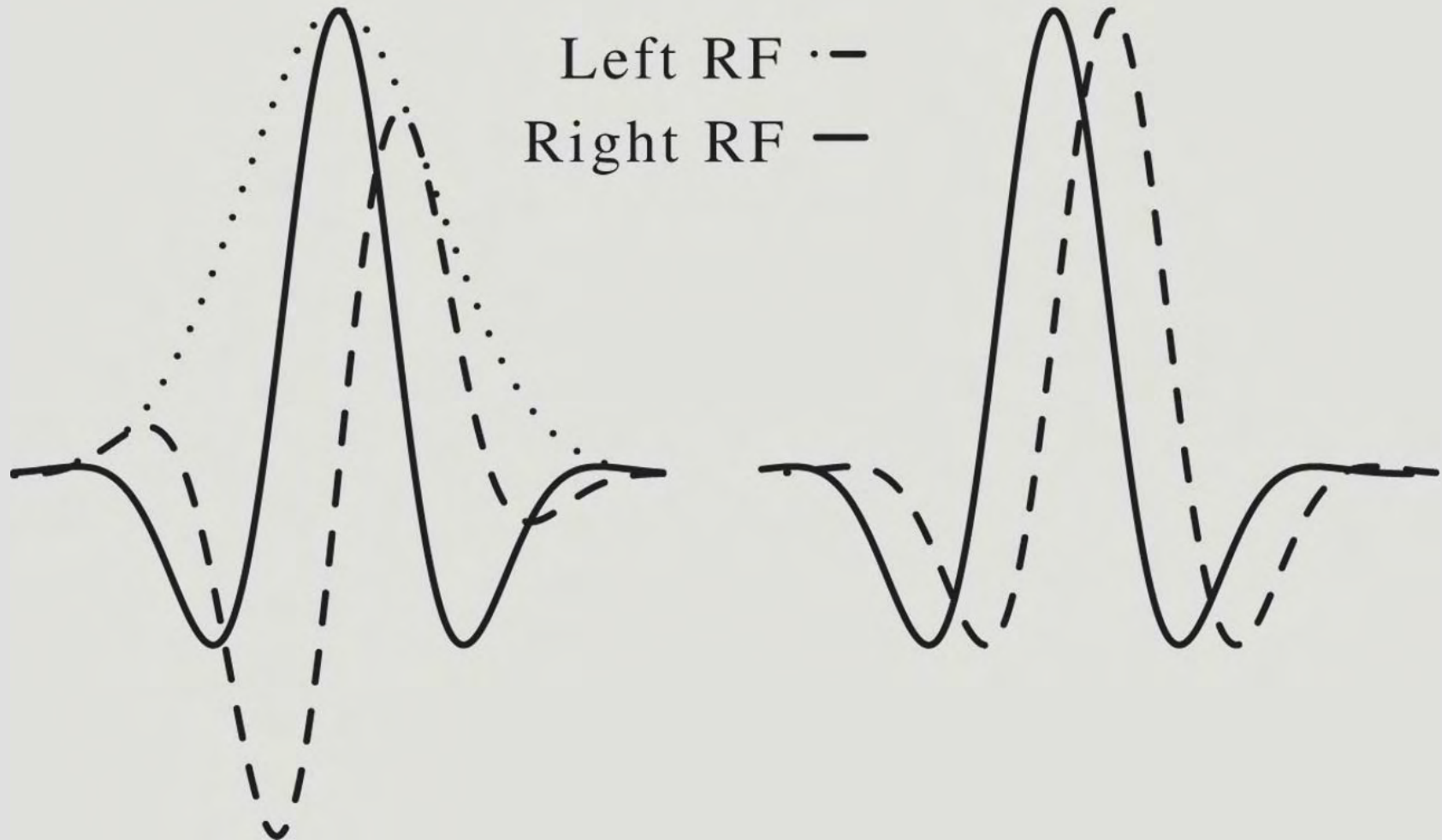
ORDRES DE DISPARITE: DERIVEES SPATIALES DE LA DISPARITE



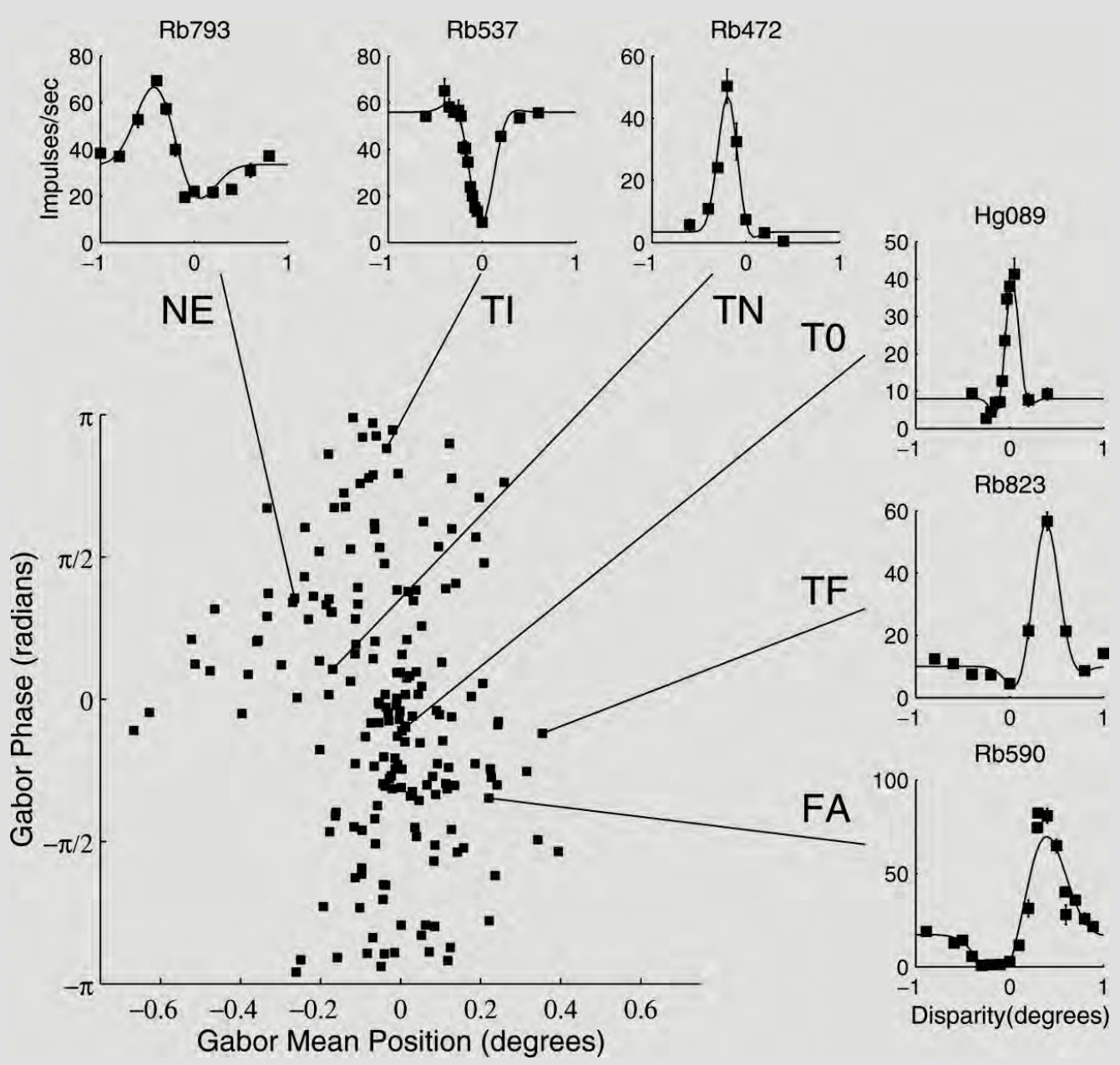
V1: MECHANISMES D'EXTRACTION DE LA DISPARITE HORIZONTALE

a) Différence de phase

b) Différence de position

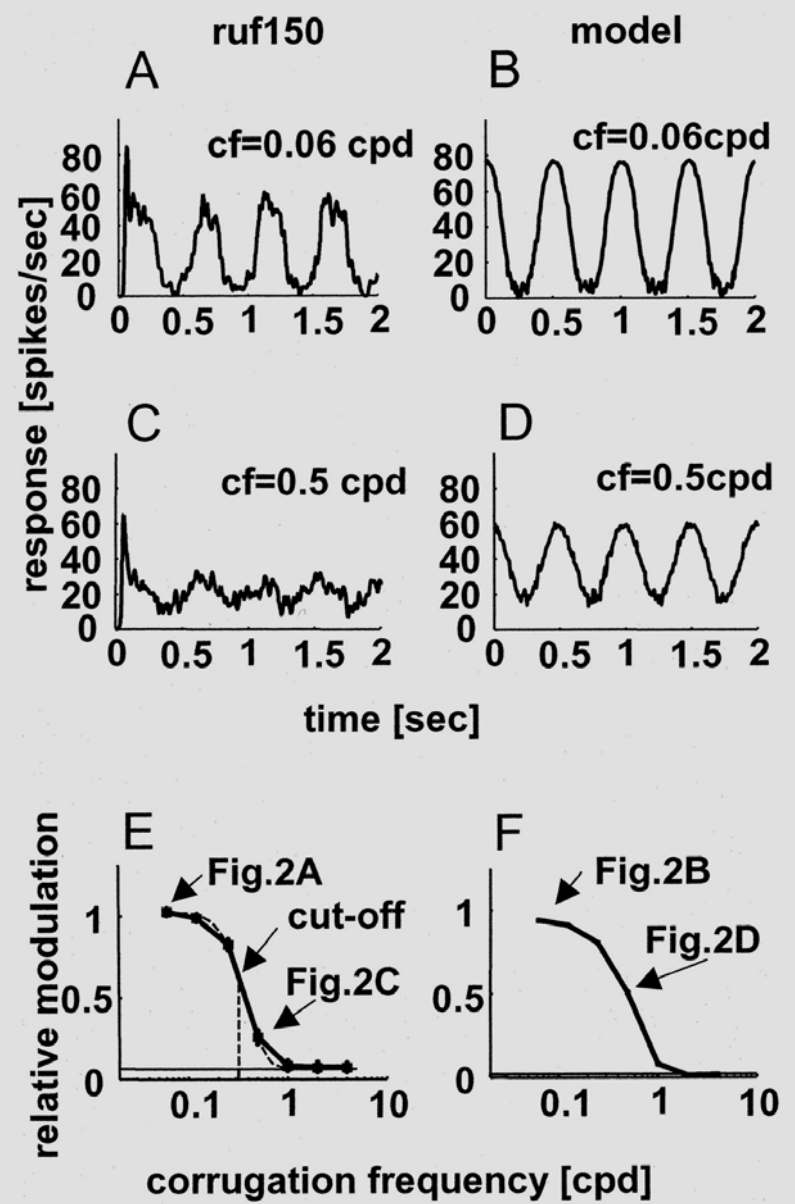
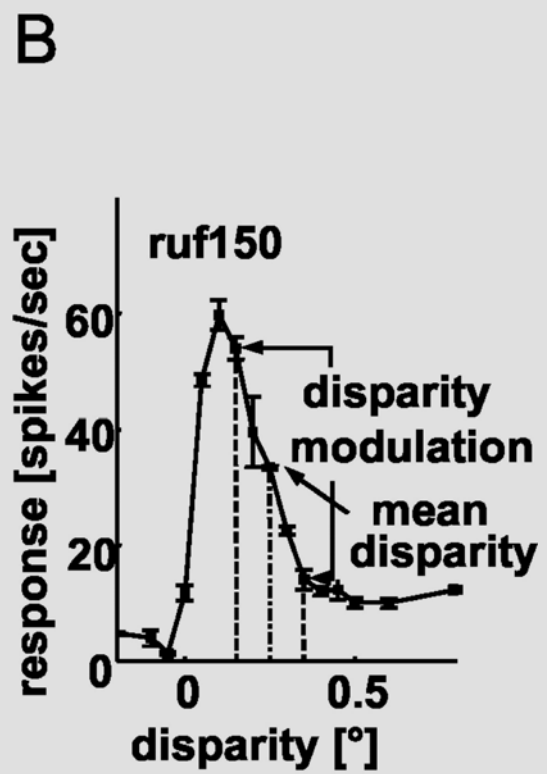
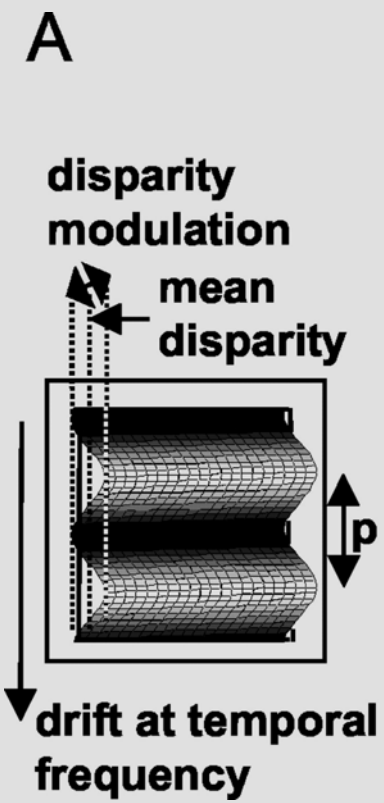


V1: NEURONES SELECTIFS POUR LA DISPARITE

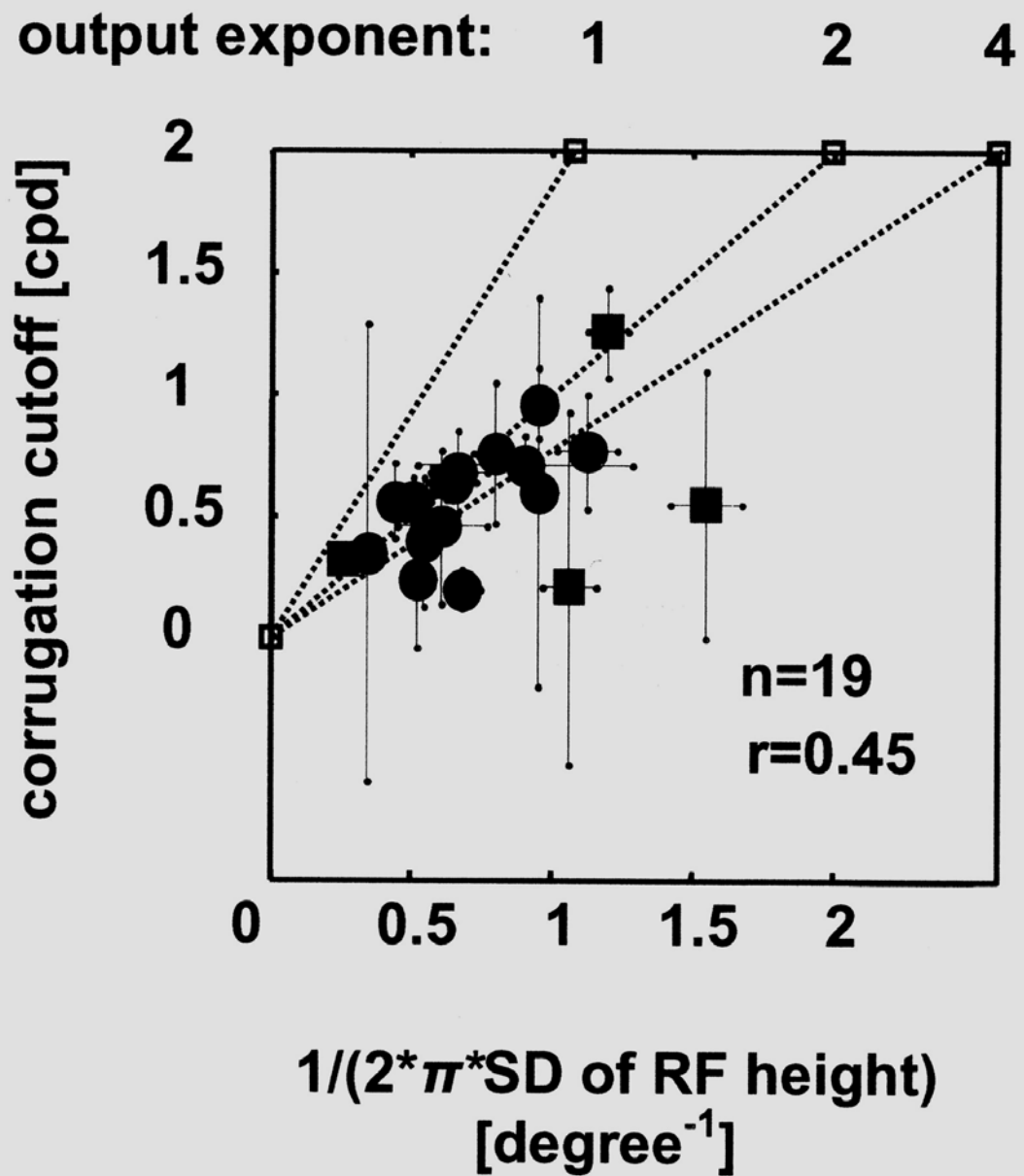


Distribution of phase and position disparities in a population of disparity-selective neurons (SJD Prince, BG Cumming, AJ Parker, submitted for publication). Tuning curves for horizontal disparity in random dot stereograms were fitted with Gabor functions. For each neuron, the fitted phase is plotted against the fitted position of the Gaussian envelope. Examples of each of the classes identified by Poggio and collaborators are shown: NE, near; TI, tuned inhibitory, TN, tuned near; TO, tuned zero; TF, tuned far; FA, far. However, there is no tendency for a grouping around any of these shapes. Rather, the shapes of disparity tuning curves for V1 seem to form a continuum.

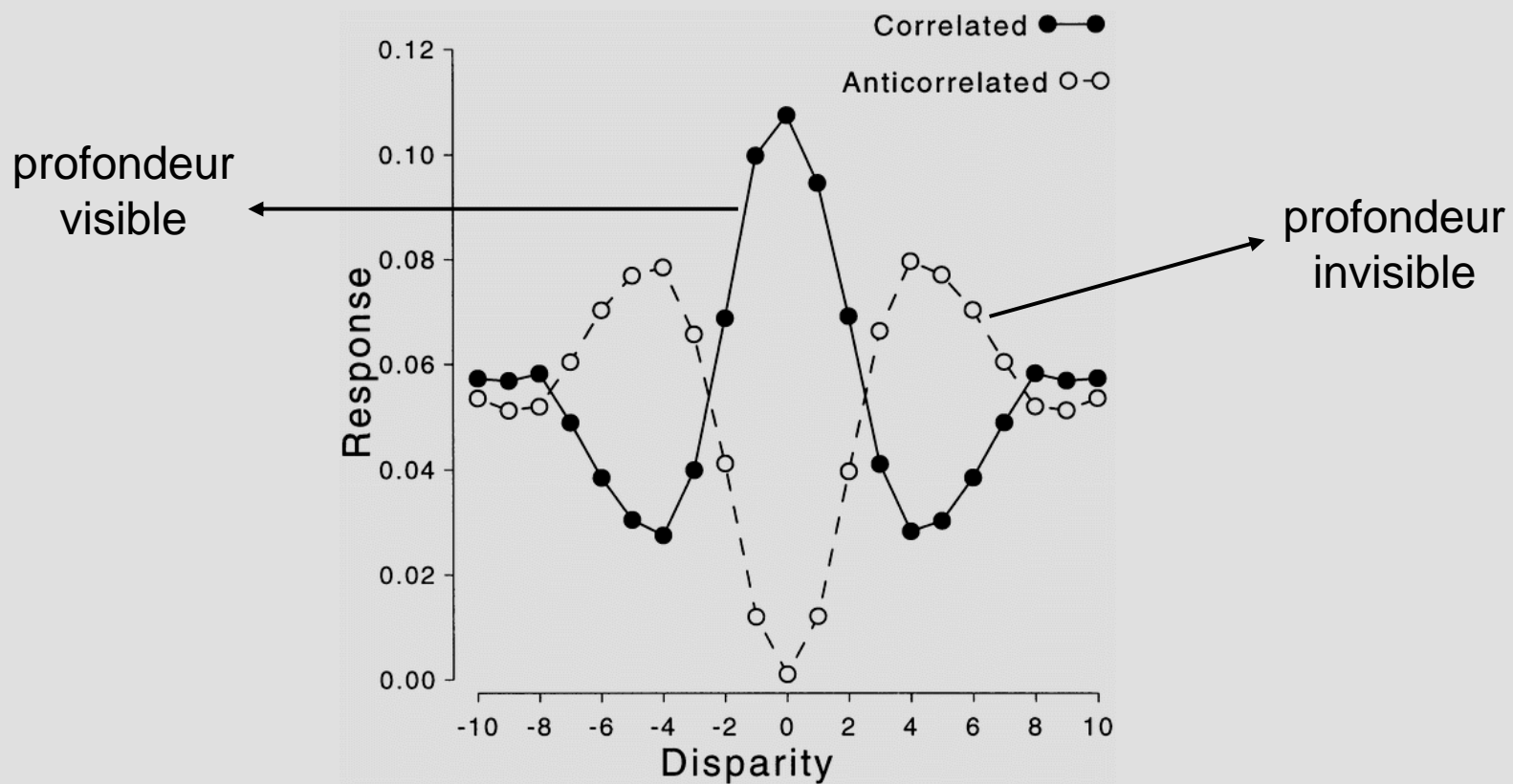
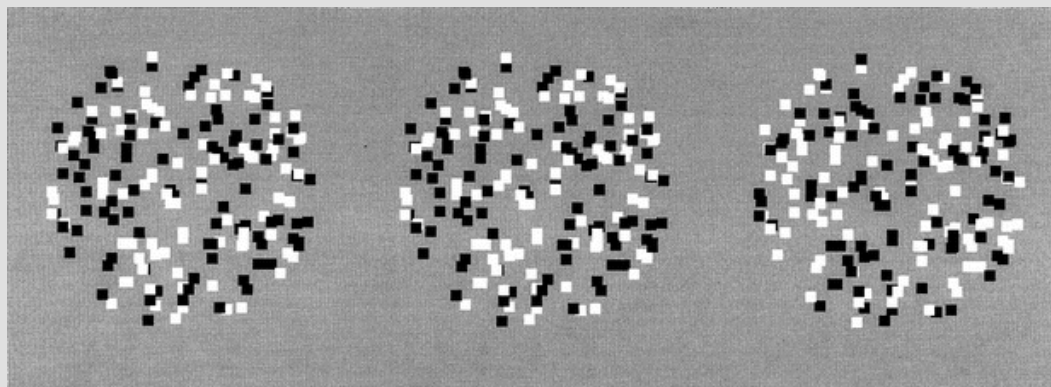
V1: REPONSE A LA MODULATION DE LA DISPARITE



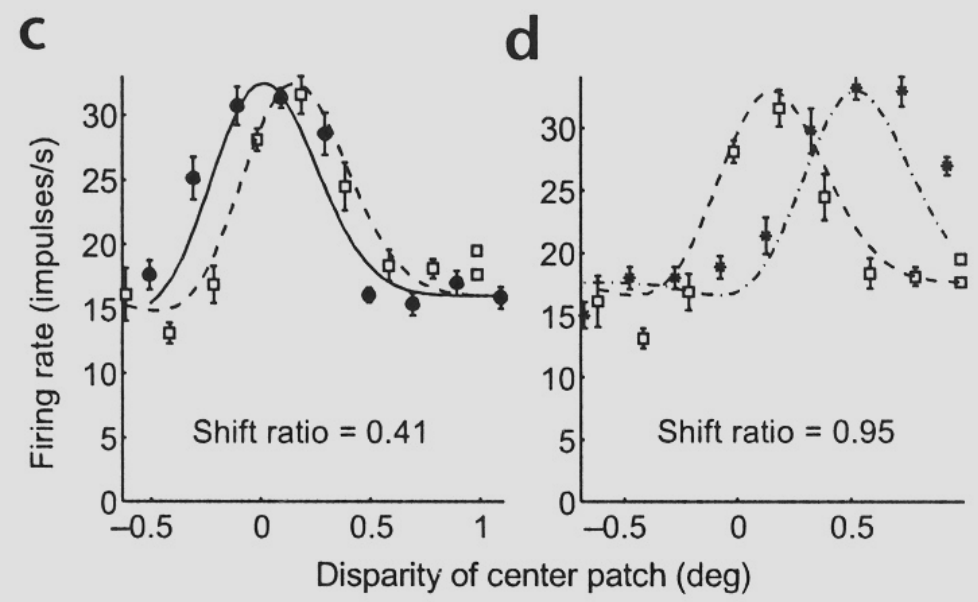
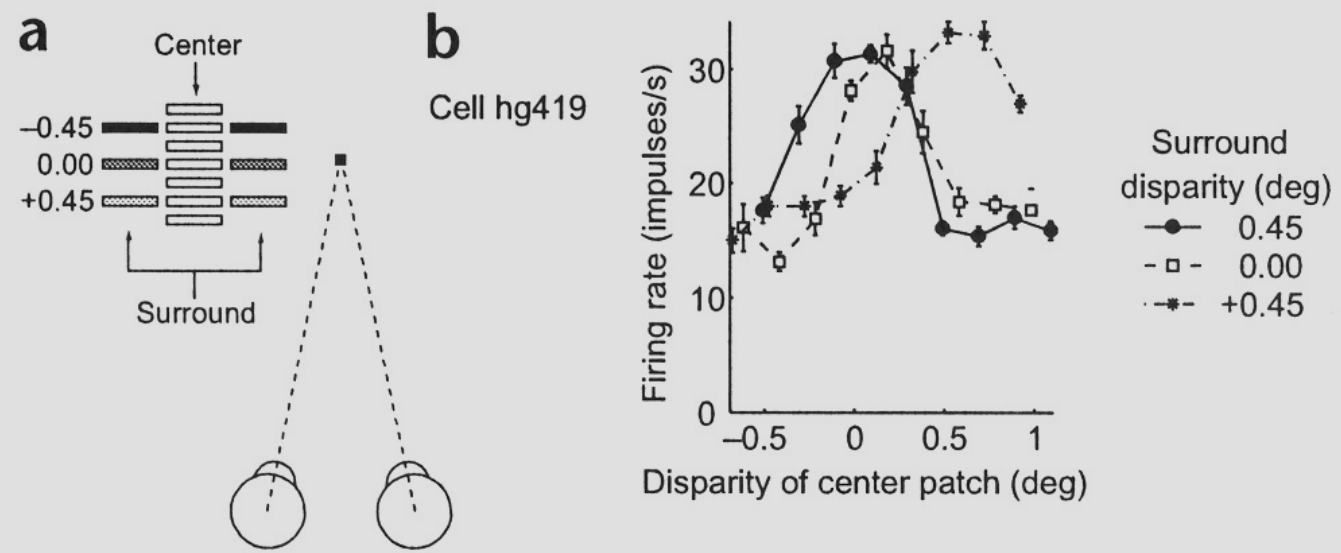
V1: CUTT-OFF PREDIT PAR LA TAILLE DU CHAMP RECEPTEUR



V1: REPONSES A DES STEREOGRAMMES ALEATOIRES ANTI-CORRELES

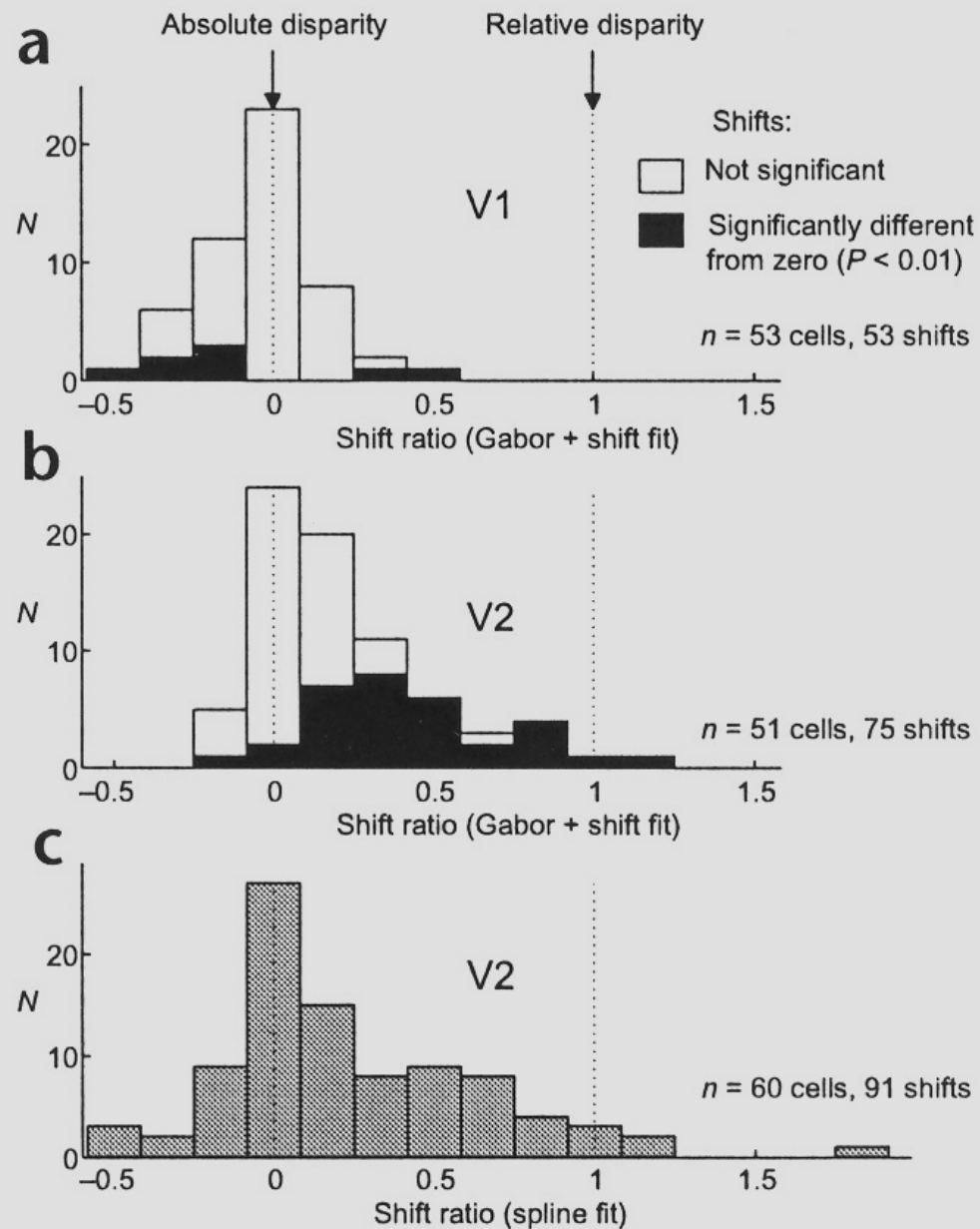


V2: SELECTIVITE POUR DISPARITE ABSOLUE ET RELATIVE

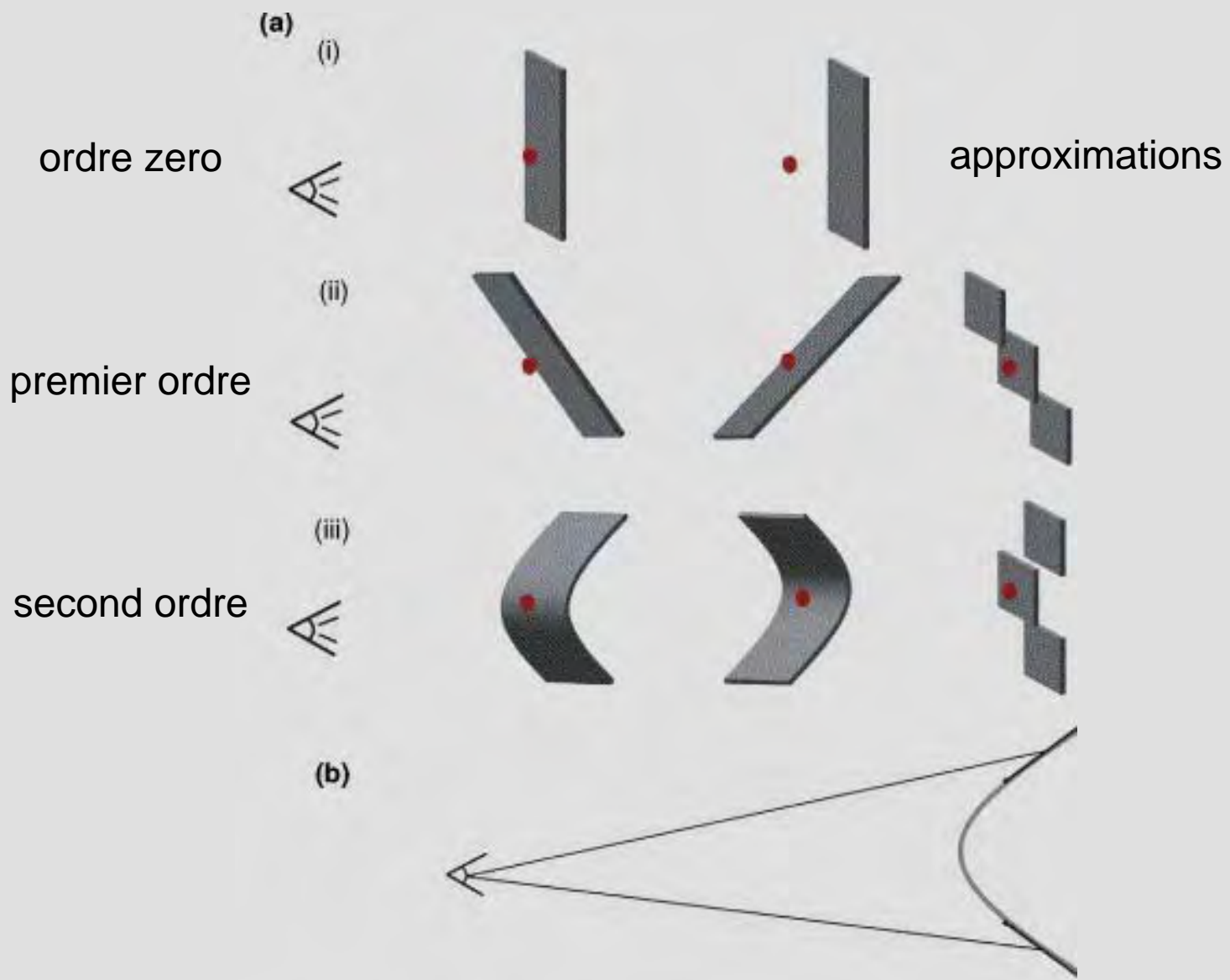


$$\frac{\text{shift reponse}}{\text{shift stimuli}}$$

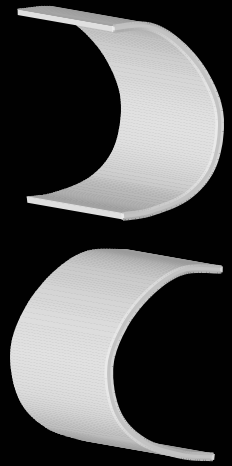
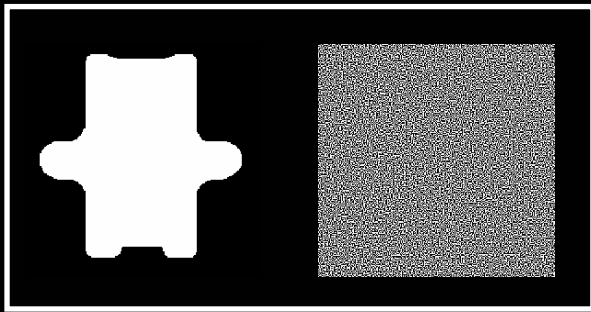
V2: SELECTIVITE POUR DISPARITE ABSOLUE ET RELATIVE



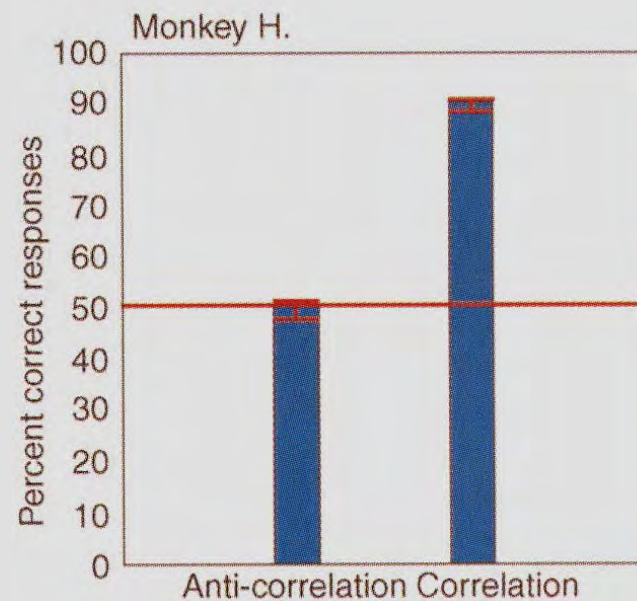
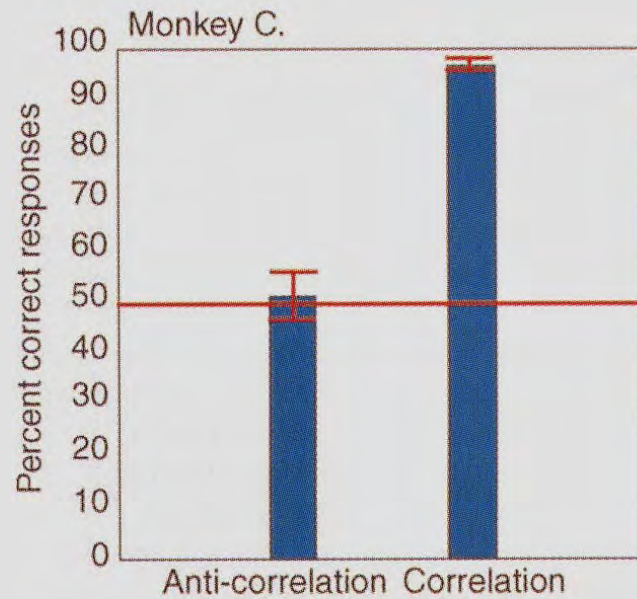
ORDRES DE DISPARITE



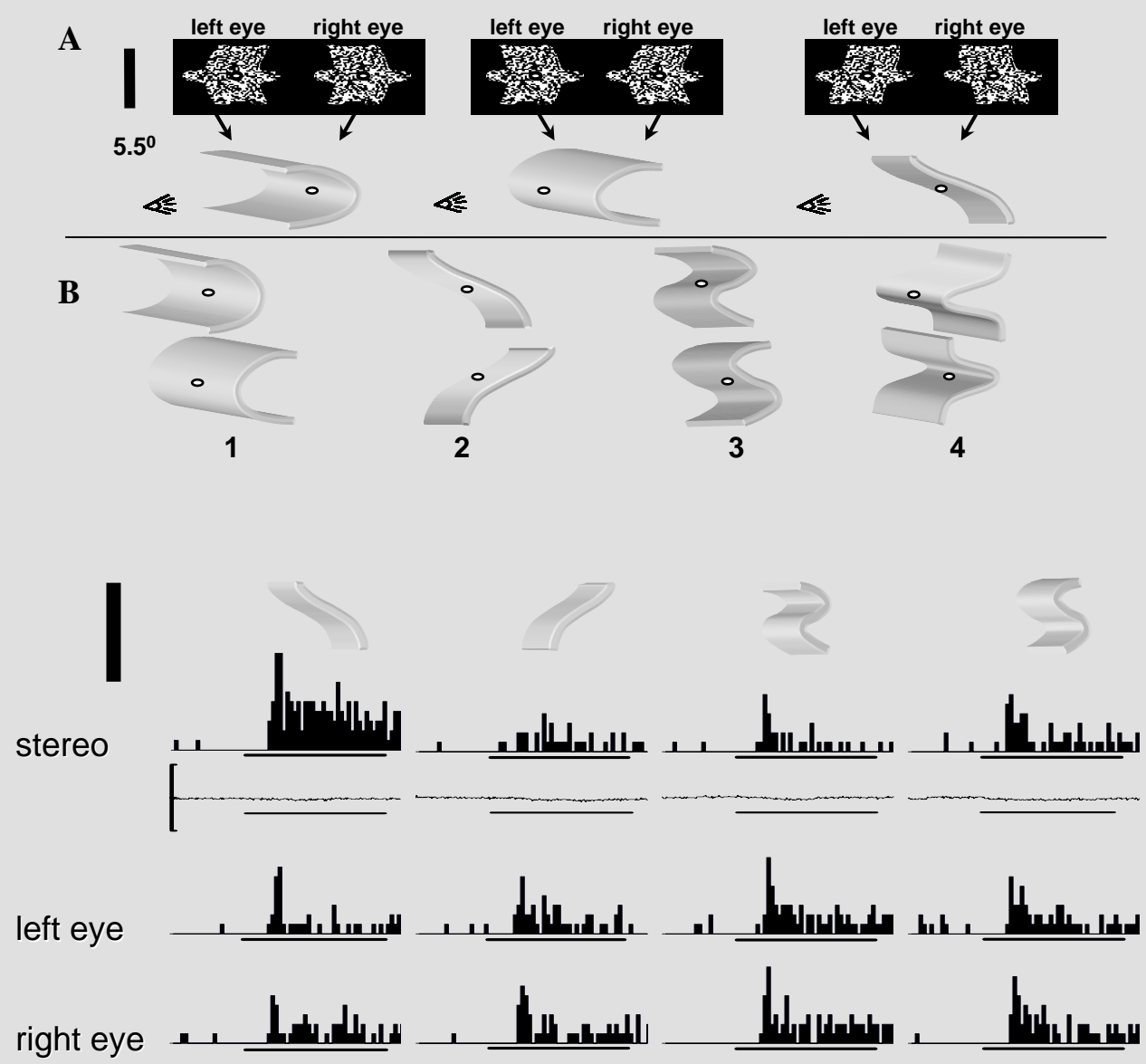
STIMULI



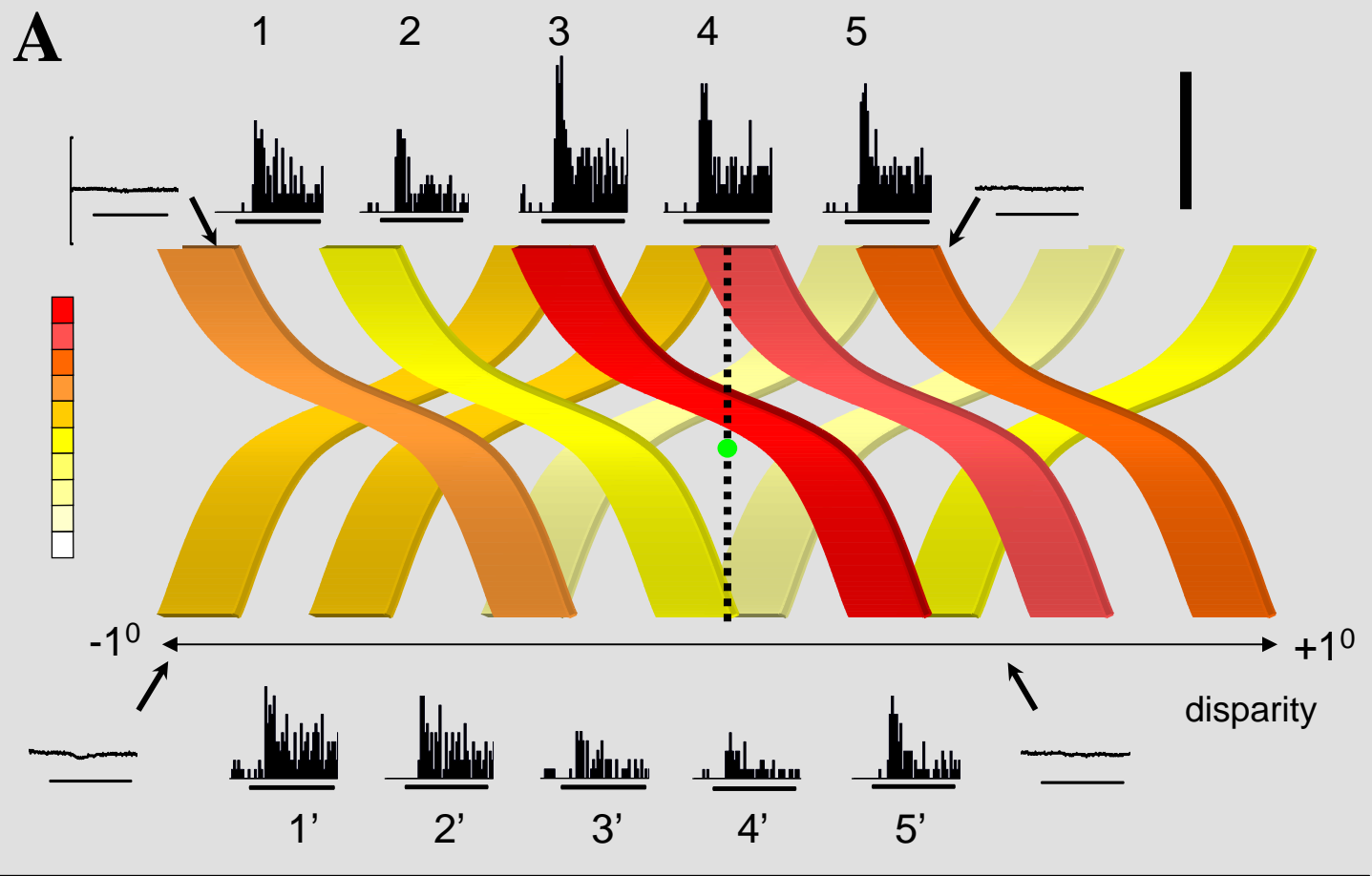
LE SINGE PERCOIT LA COURBURE TRI-DIMENSIONNELLE



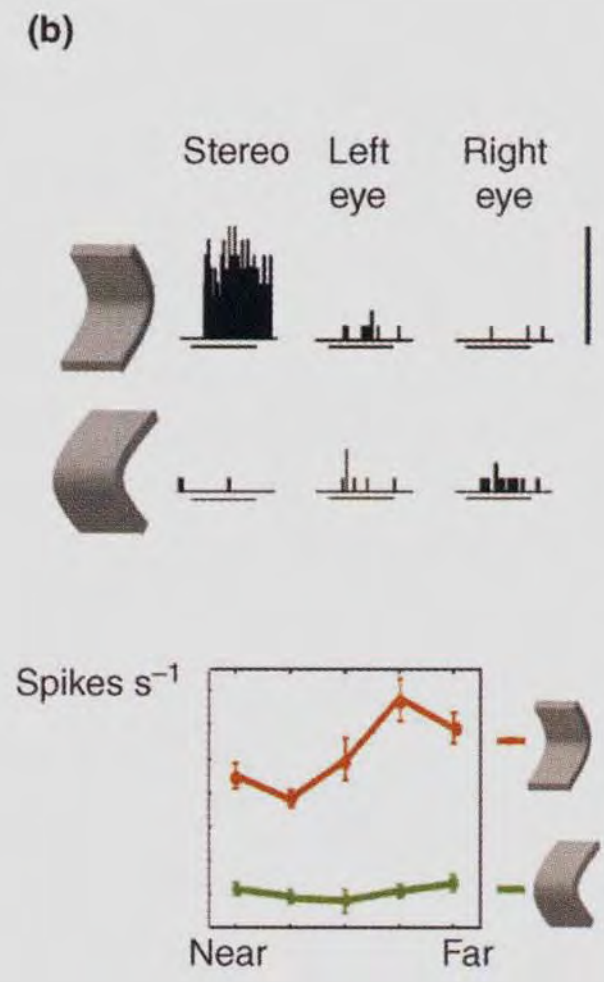
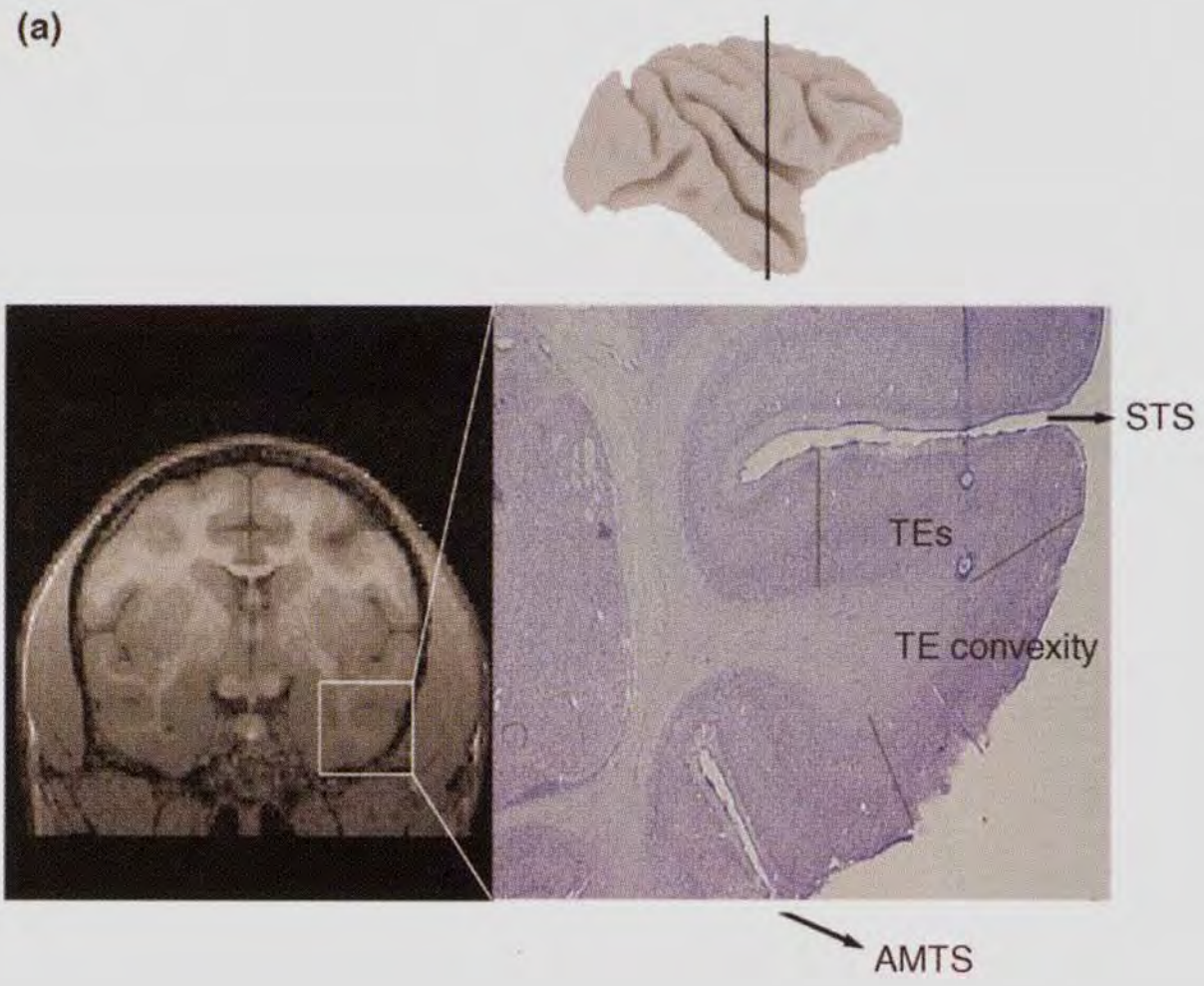
TEs: SELECTIVITE POUR LA DISPARITE D'ORDRE SUPERIEUR



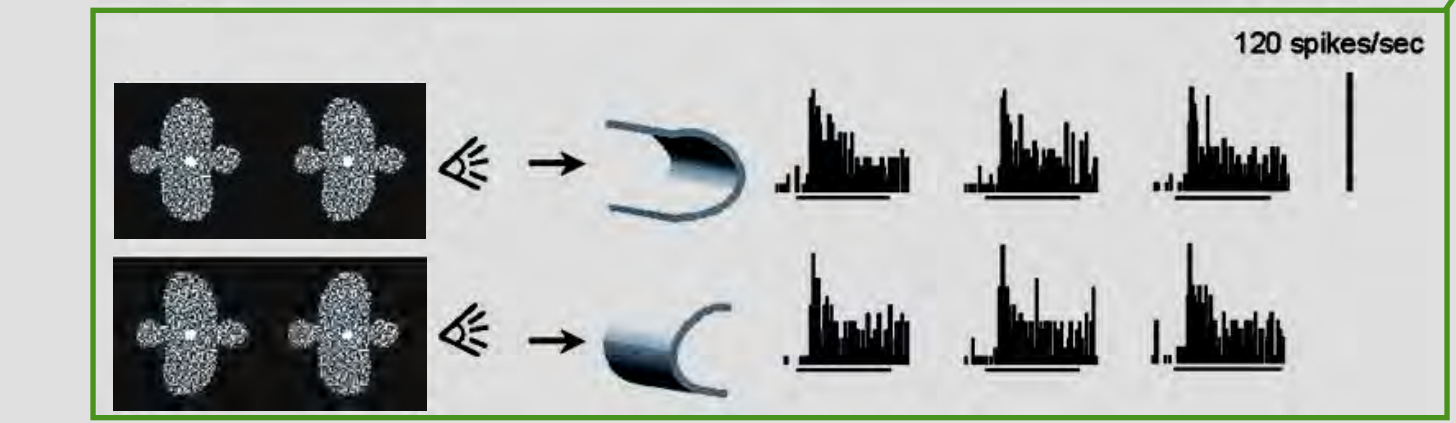
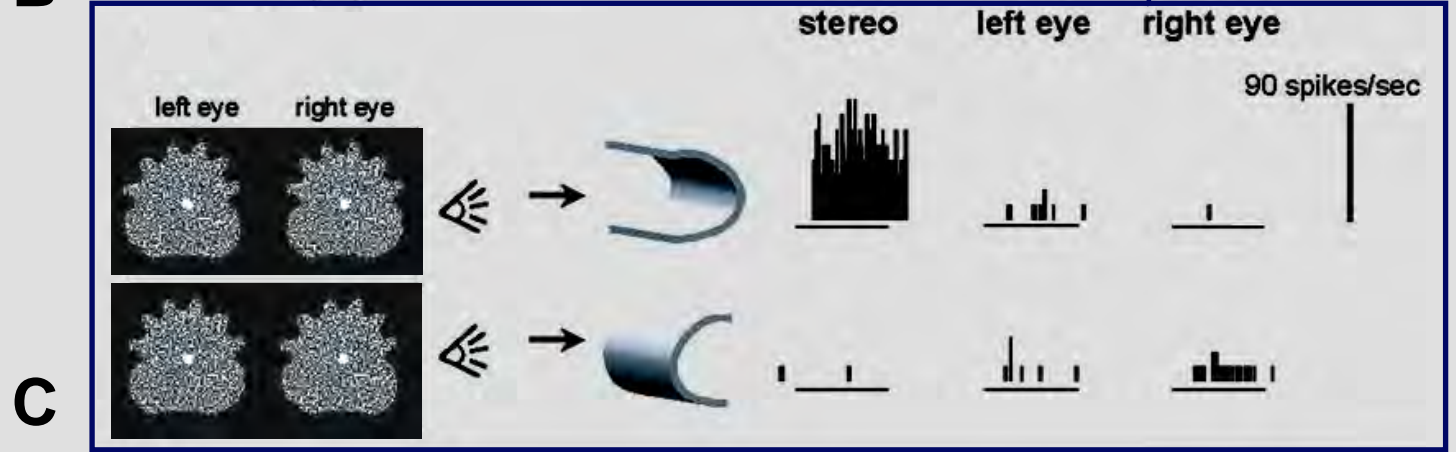
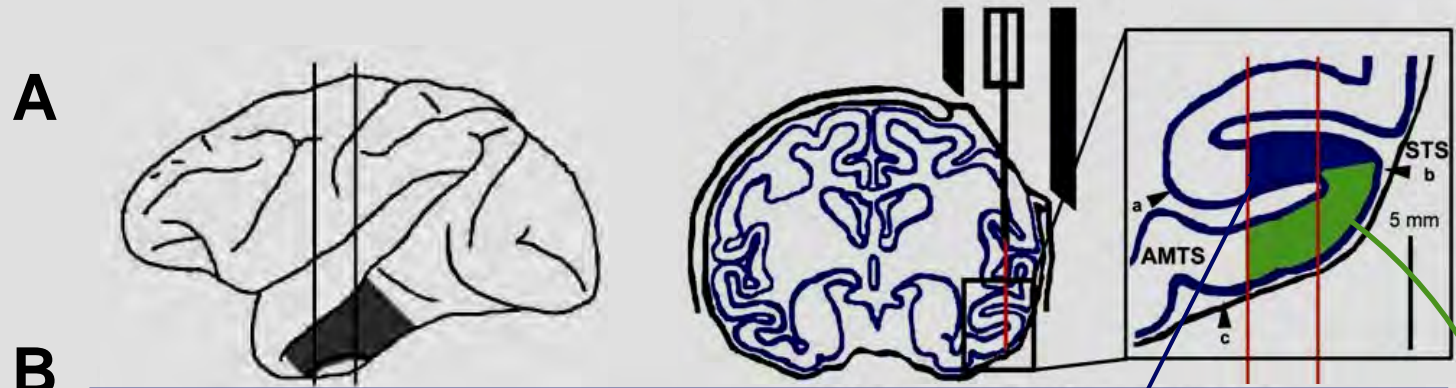
TEs: SELECTIVITE POUR LA DISPARITE D'ORDRE SUPERIEUR



TEs: SELECTIVITE POUR LA DISPARITE D'ORDRE SUPERIEUR



COMPARISON TES ET LA CONVEXITE DE L'INFERO TEMPORAL



STIMULI D'ORDRE DECROISSANT

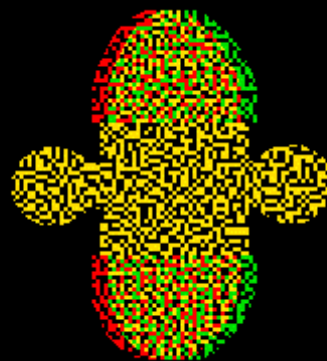
Second ordre:
original



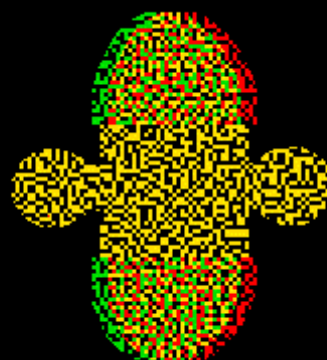
Approximation
linéaire



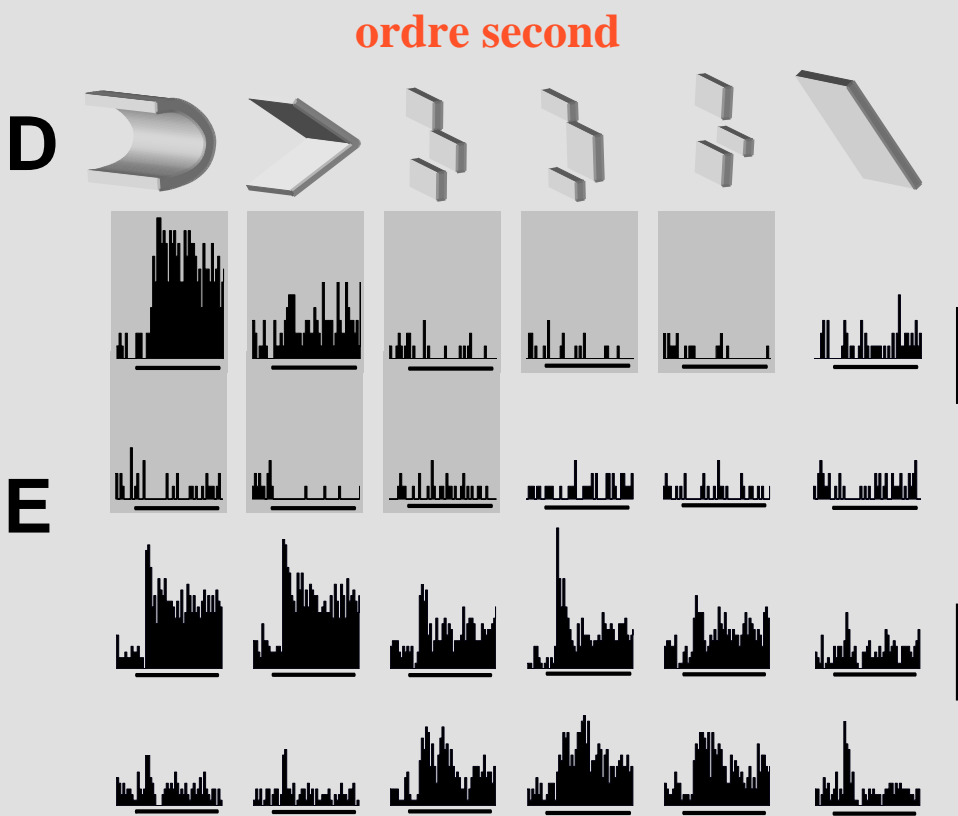
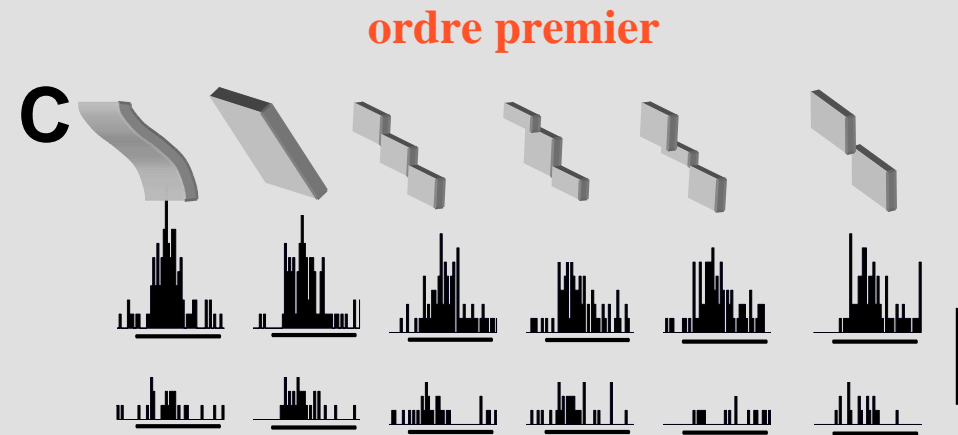
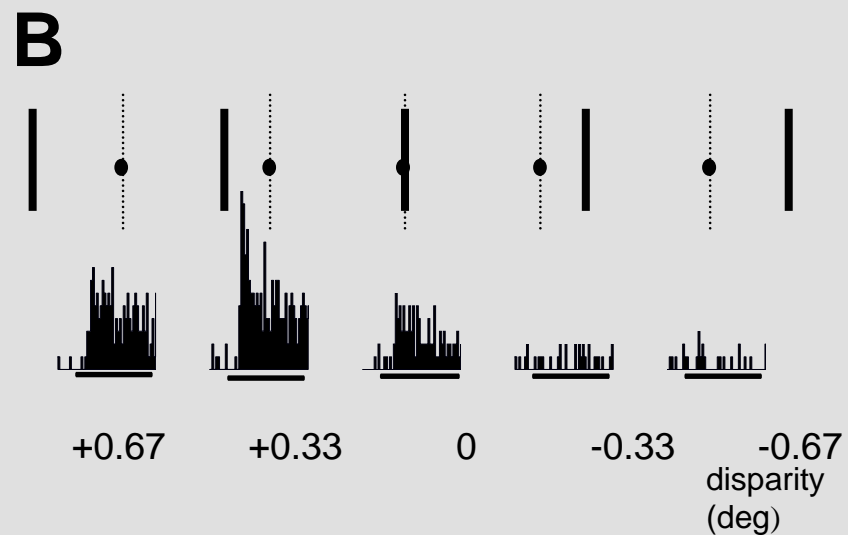
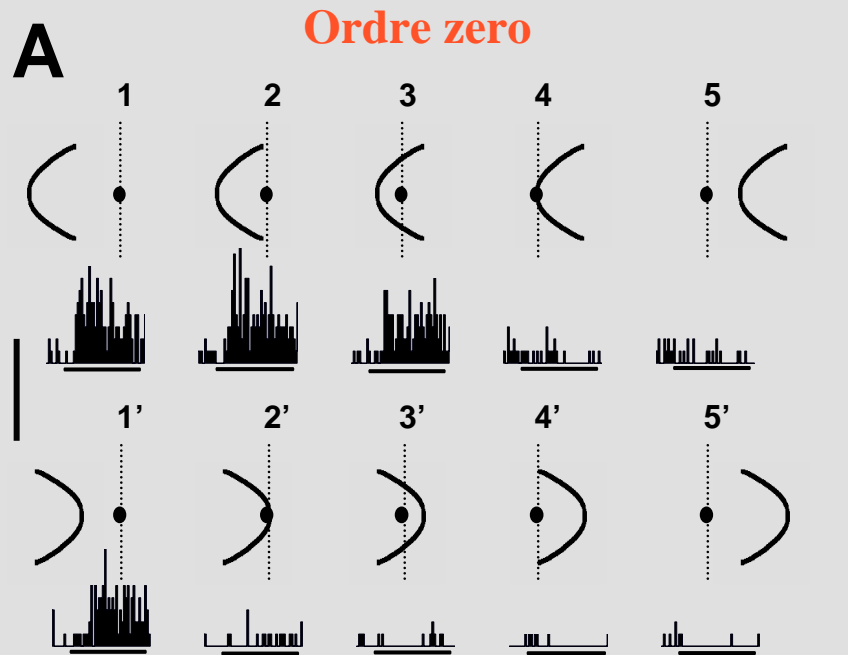
Approximation
discrète



Premier
ordre



TEs: SELECTIVITE POUR LES DIFFERENTS ORDRES DE DISPARITE



TEs: CODAGE DU DEGRE DE COURBURE



Degré de variation de la disparité

1.3deg

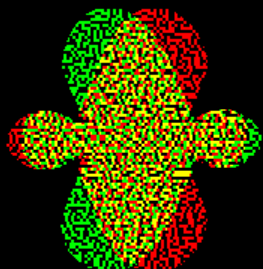
0.65deg

0.32deg

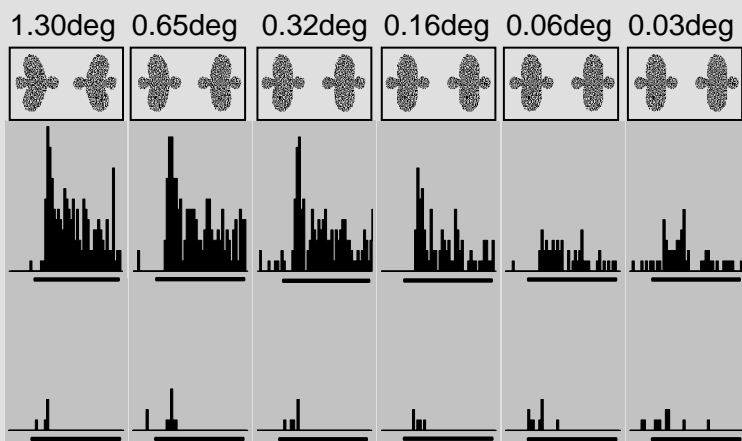
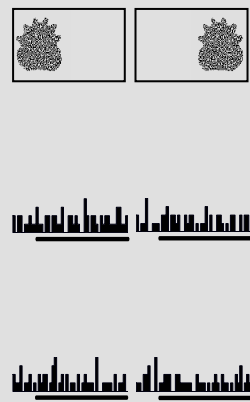
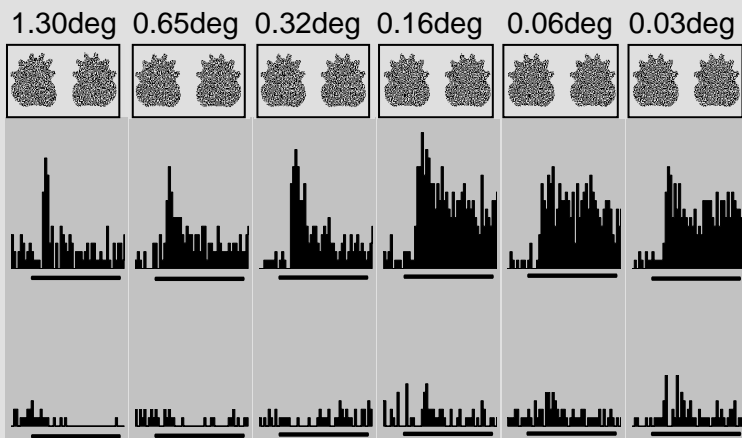
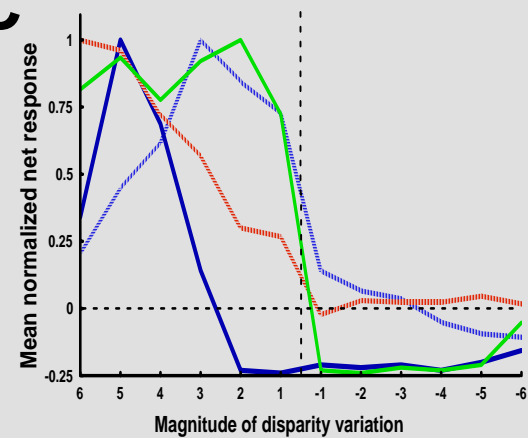
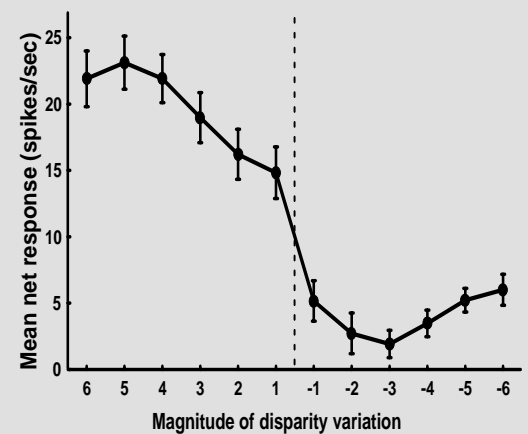
0.16deg

0.06deg

0.03deg

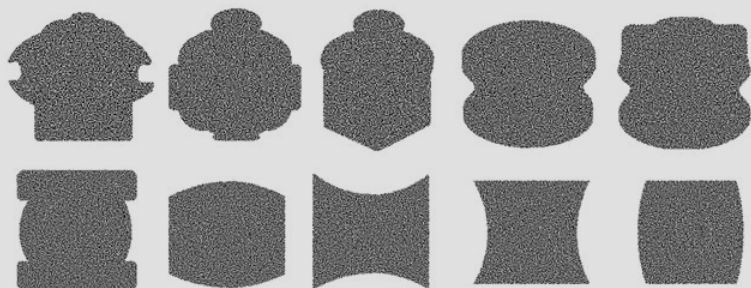


TEs: CODAGE DU DEGRE DE COURBURE

A**B****C****D**

TESTS DE SELECTIVITE DU BORD OU DE LA SURFACE

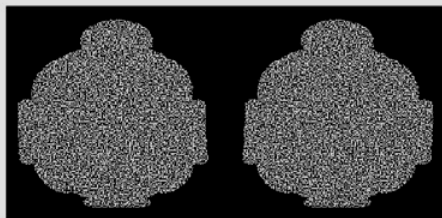
A



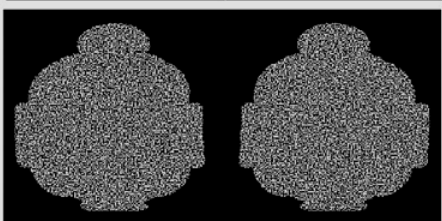
B

vertical

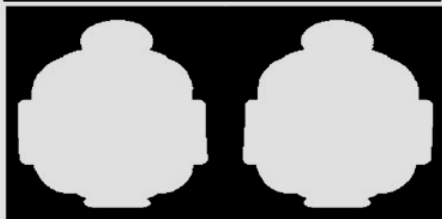
correlation



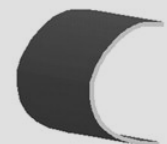
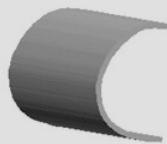
decorrelation



solid

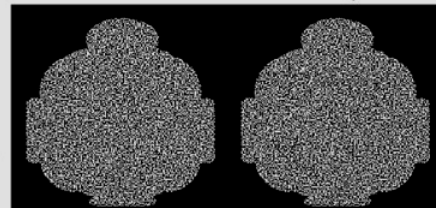


rim

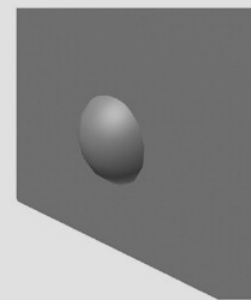
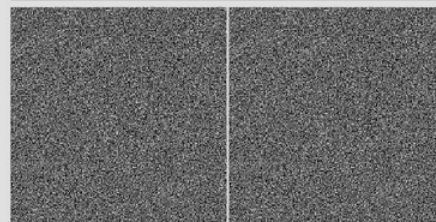


C

vertical+horizontal (surface)



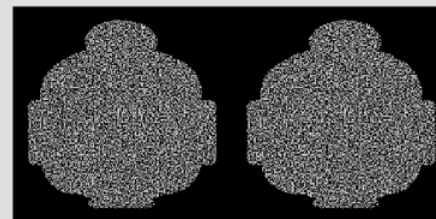
large surface restricted surface



D

horizontal

correlation



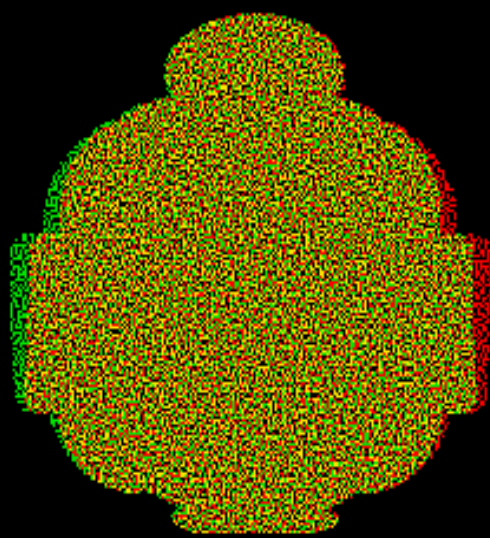
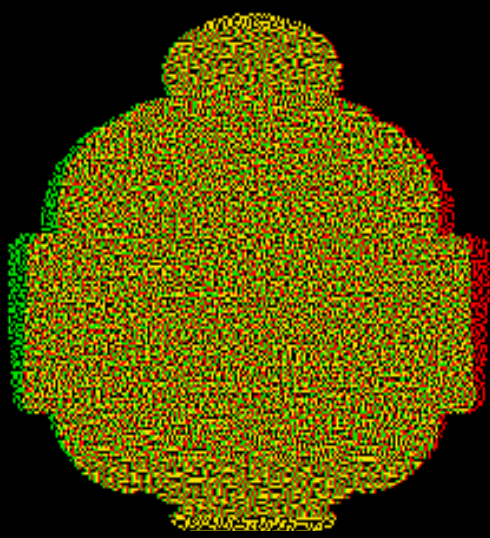
TESTS DU BORD DE LA FORME 3D

Corrélation

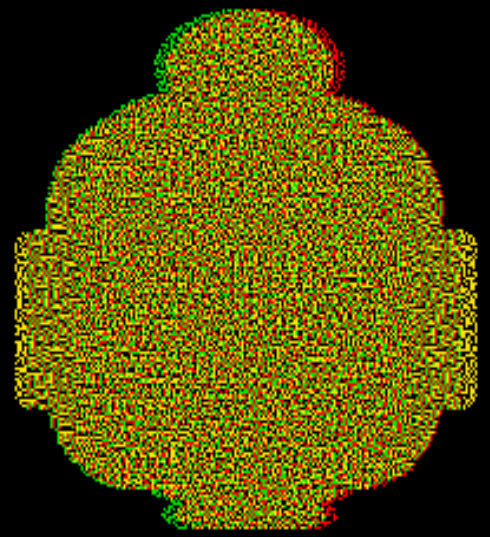
Decorrélation

Forme pleine

Variation
verticale



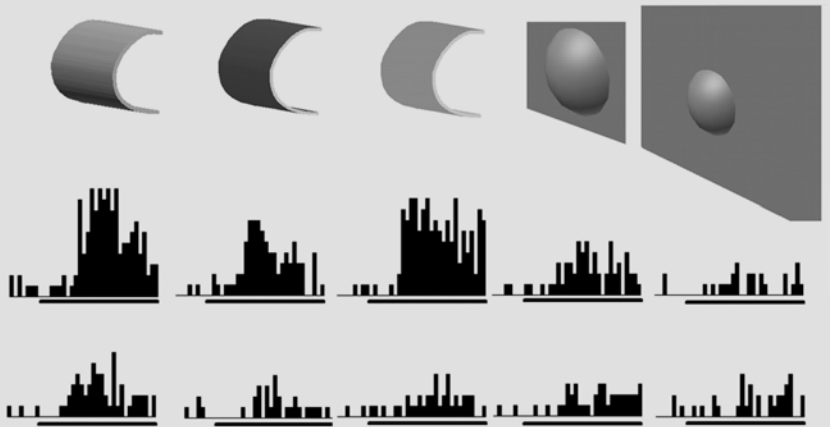
Variation
horizontale



TEs: NEURONES SELECTIFS POUR LA SURFACE ET LE BORD

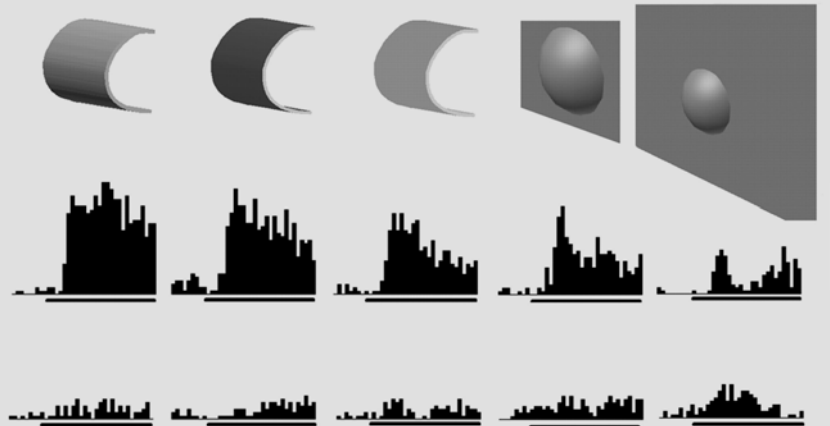
A bord suffisant

correlation decorrelation solid restricted surface large surface



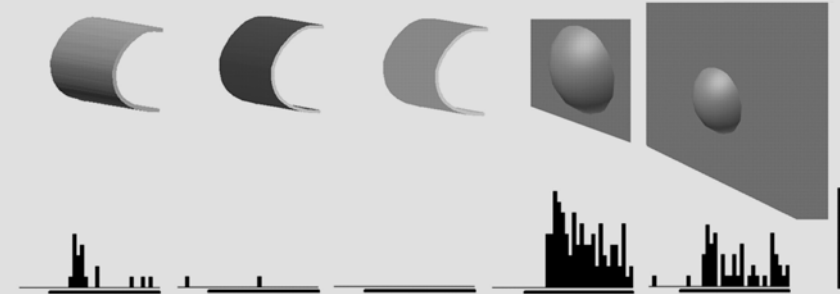
B bord & surface suffisants

correlation decorrelation solid restricted surface large surface

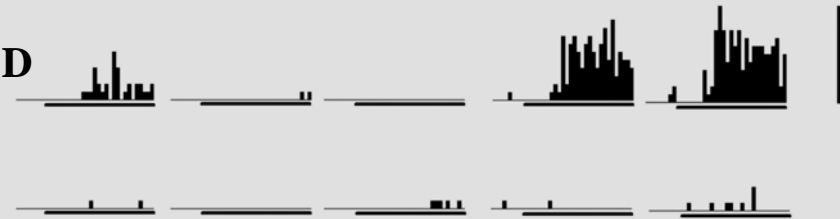


C surface suffisante

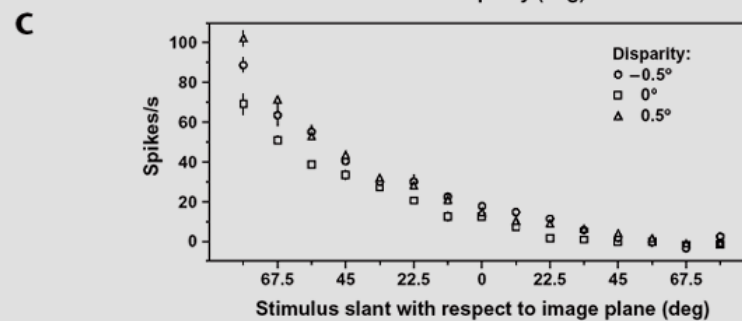
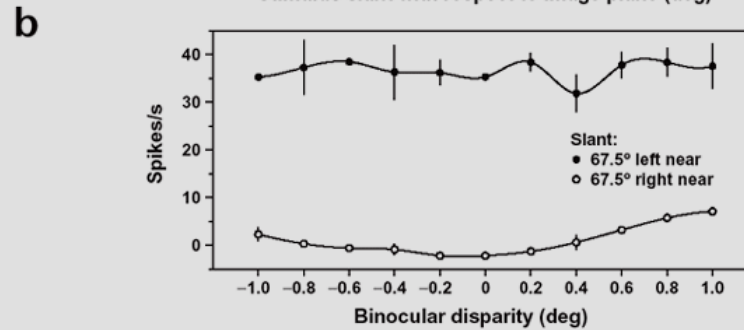
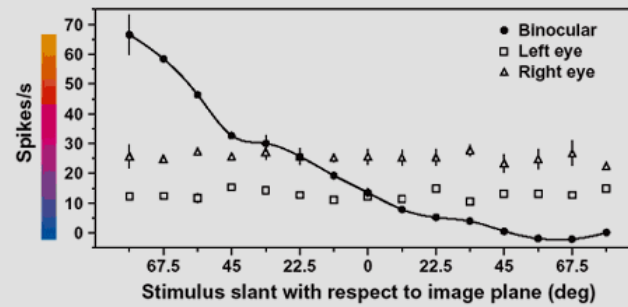
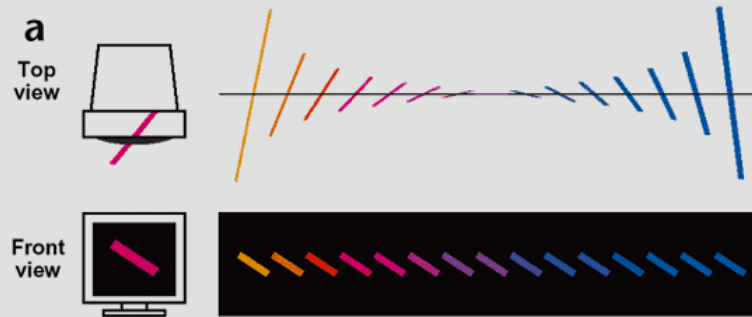
correlation decorrelation solid restricted surface large surface



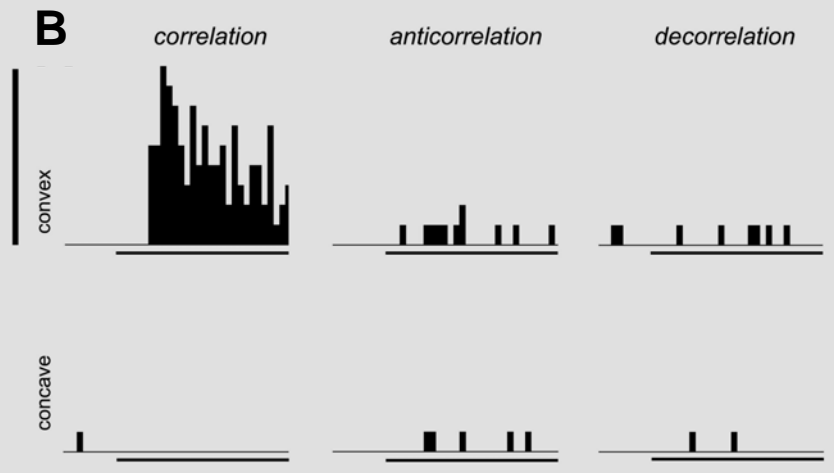
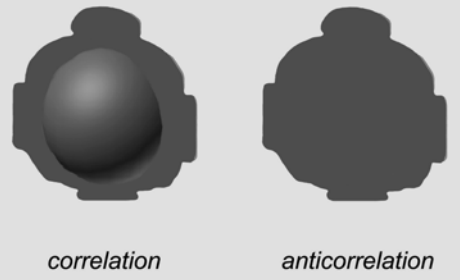
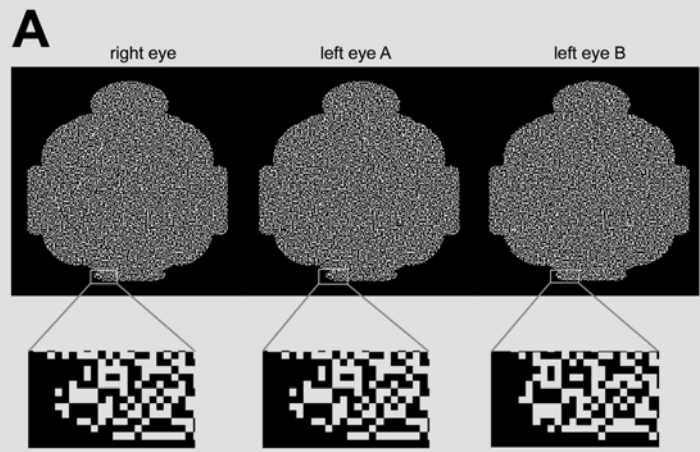
D



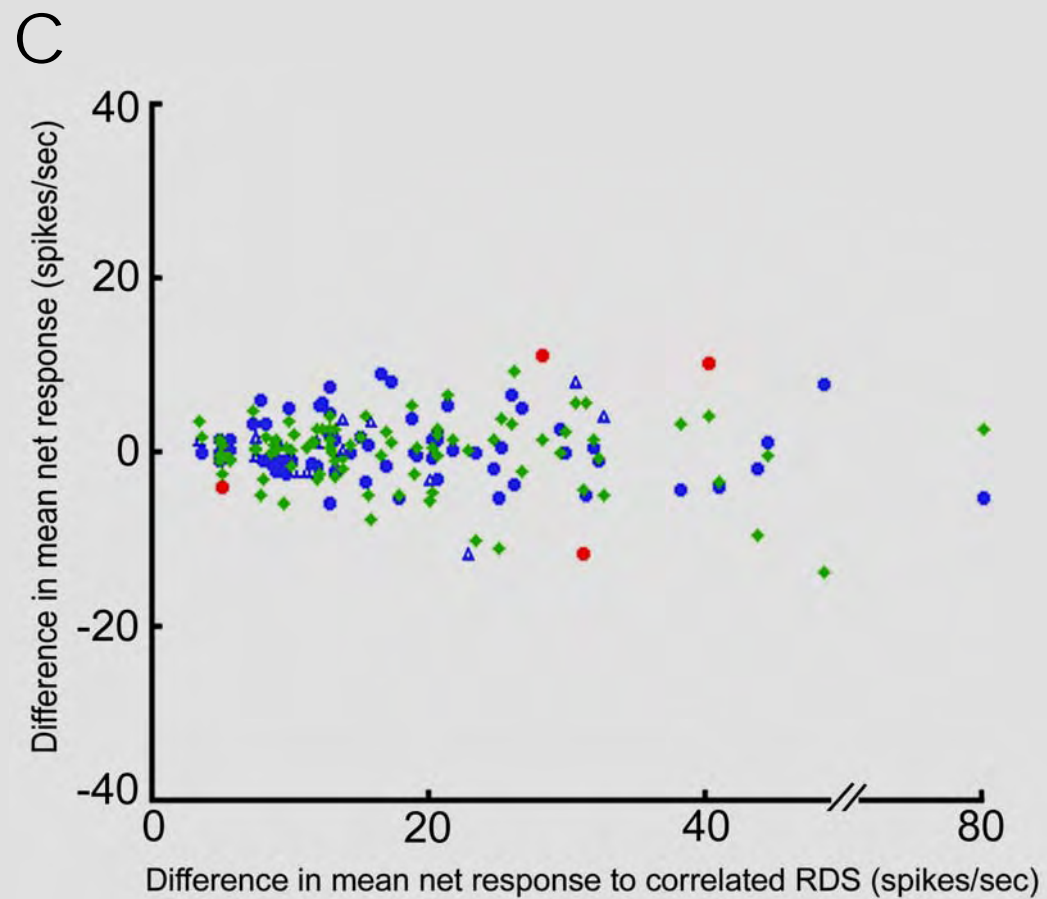
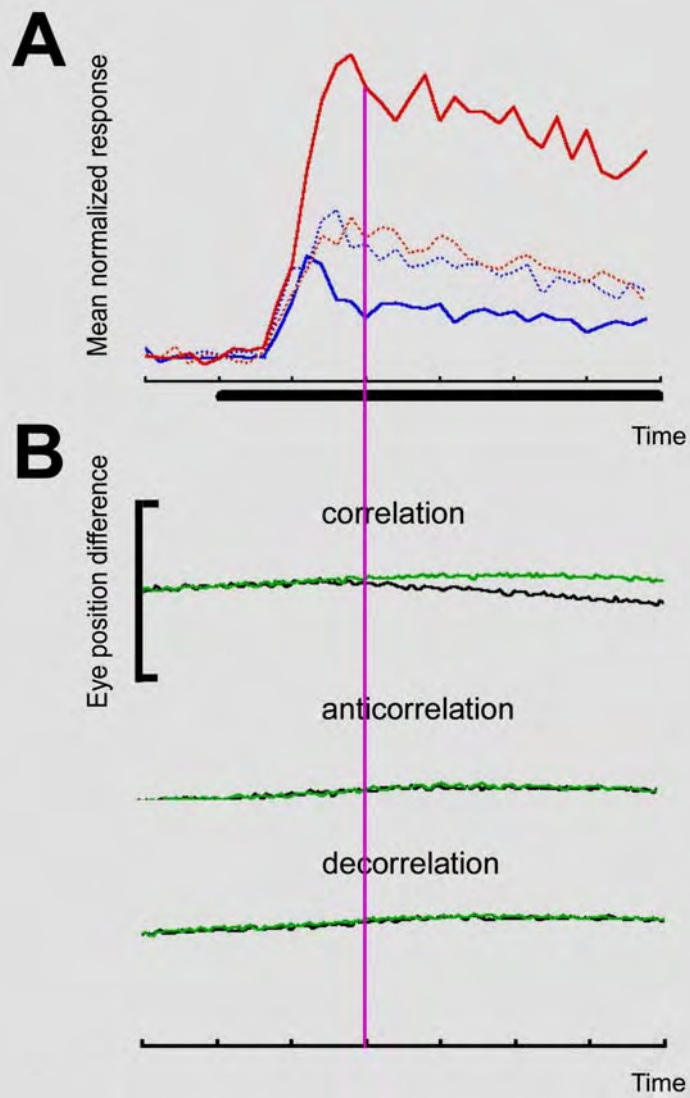
V4: SELECTIVITE POUR L'ORIENTATION EN PROFONDEUR (Barres)



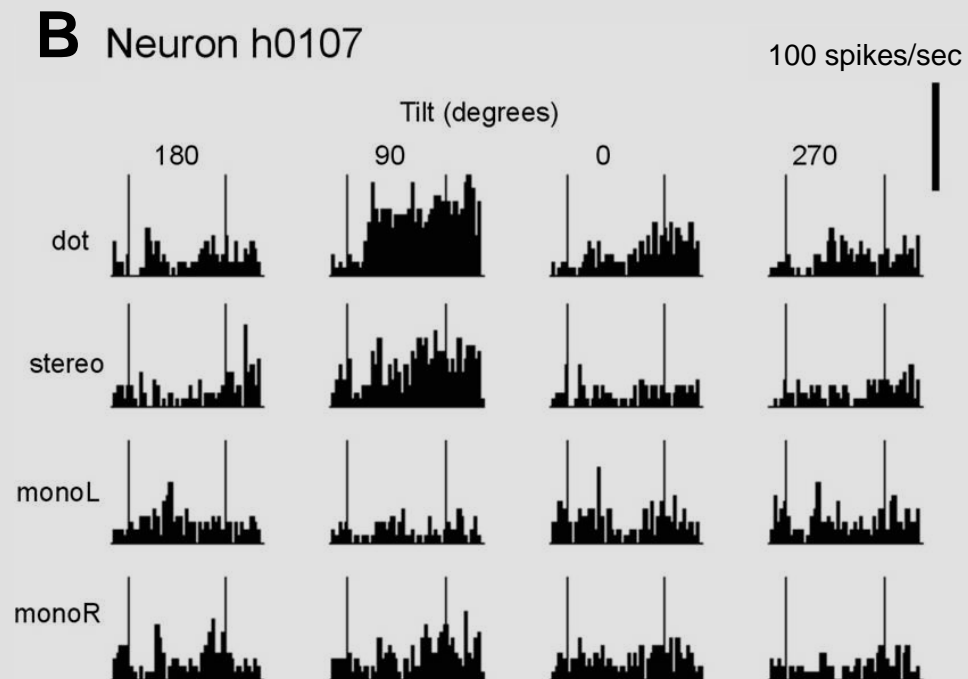
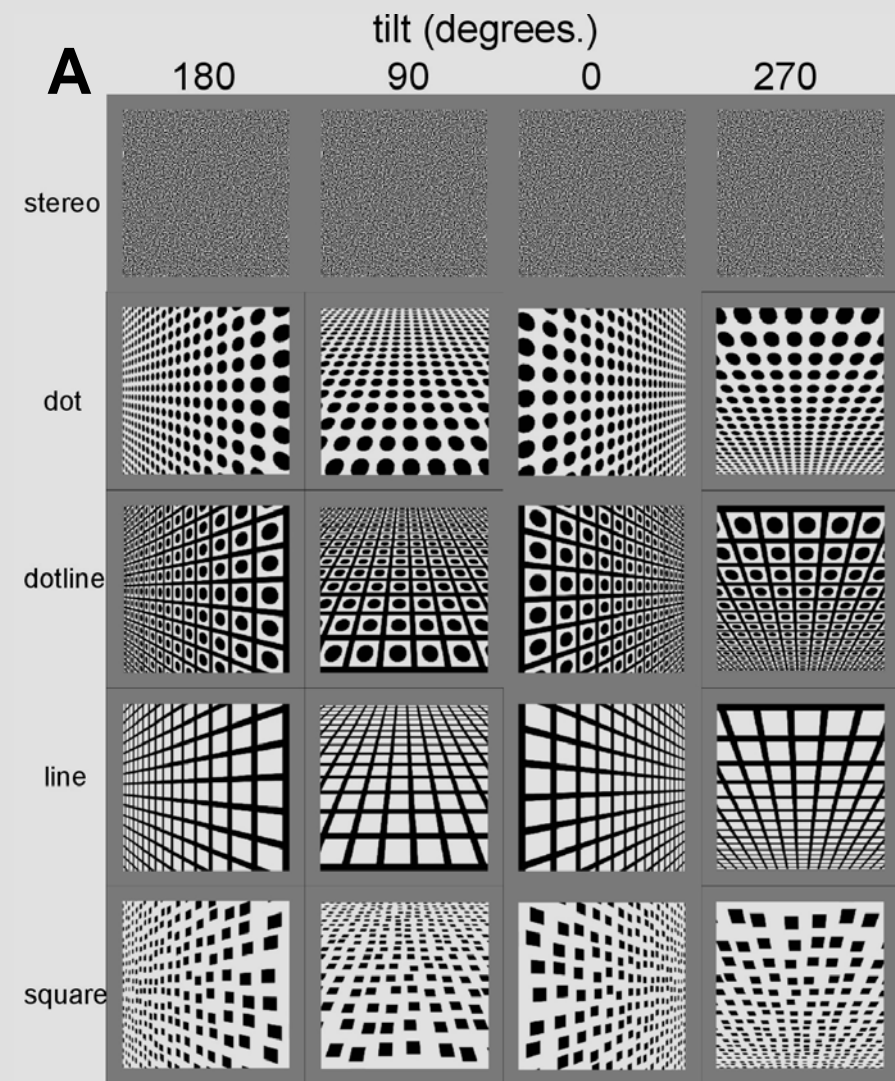
TEs: LE PROBLEME DE CORRESPONDENCE EST RESOLU

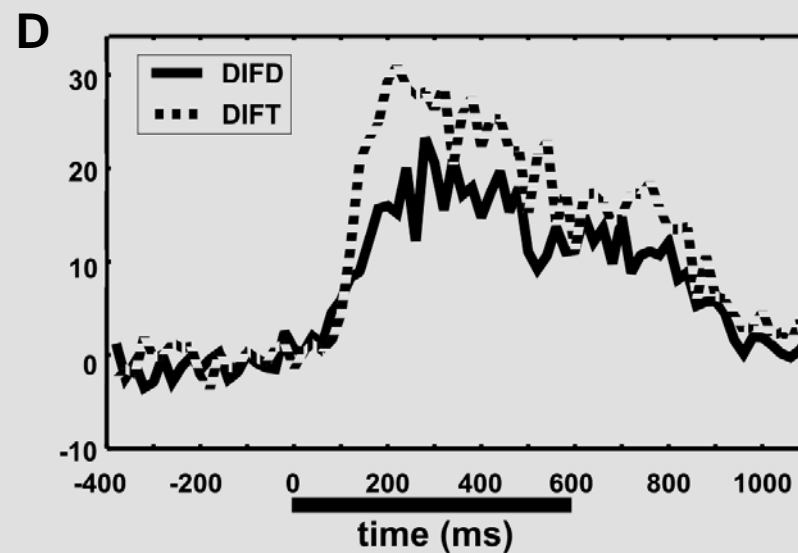
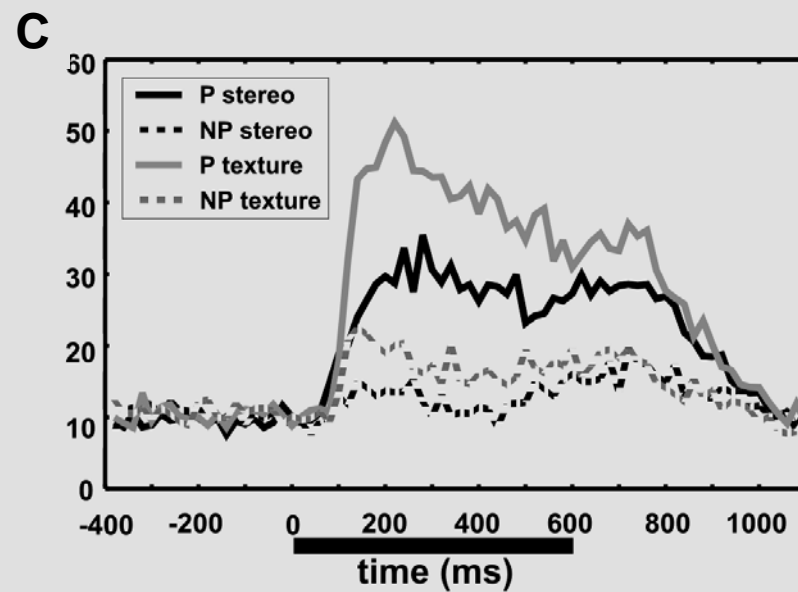
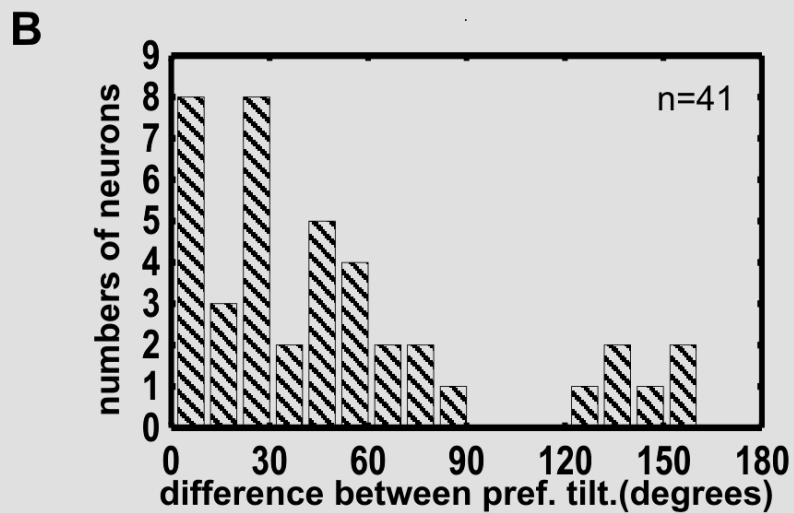
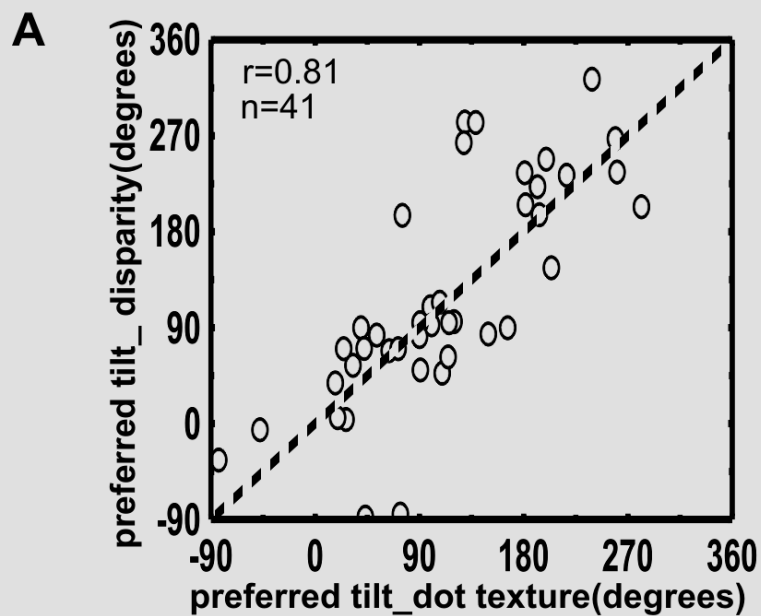


TEs: LE PROBLEME DE CORRESPONDENCE EST RESOLU



TEs: CONVERGENCES DES SOURCES D'INFORMATION 3D





fMRI: SENSIBILITE A LA COURBURE EN PROFONDEUR

Disparité binoculaire

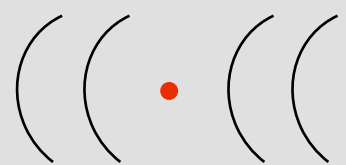
Stereo

Monoculaire

Deux yeux:
images differentes

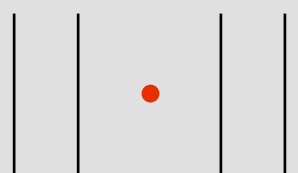
Deux yeux:
mêmes images

Courbées



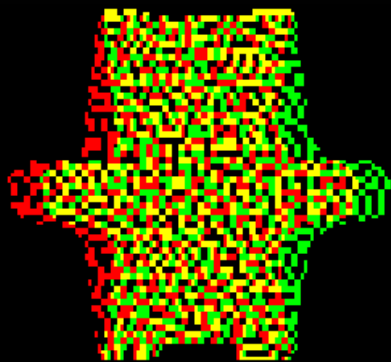
Surfaces

Planes

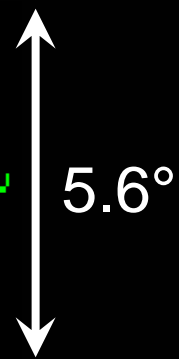
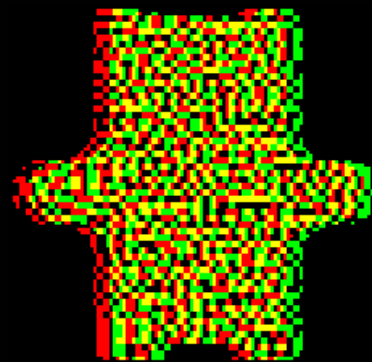


STIMULI: SURFACES

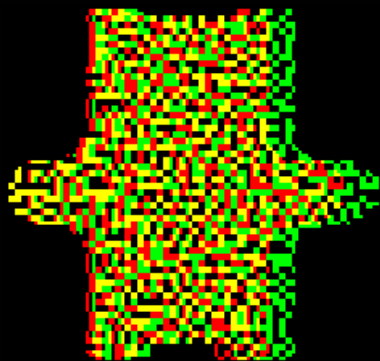
3D courbure
ordre second



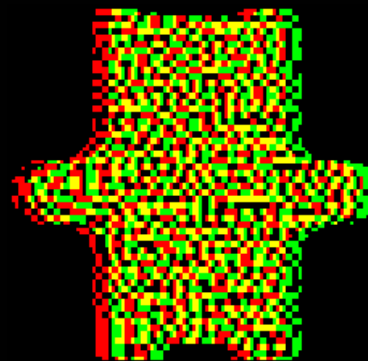
3D position
ordre zero



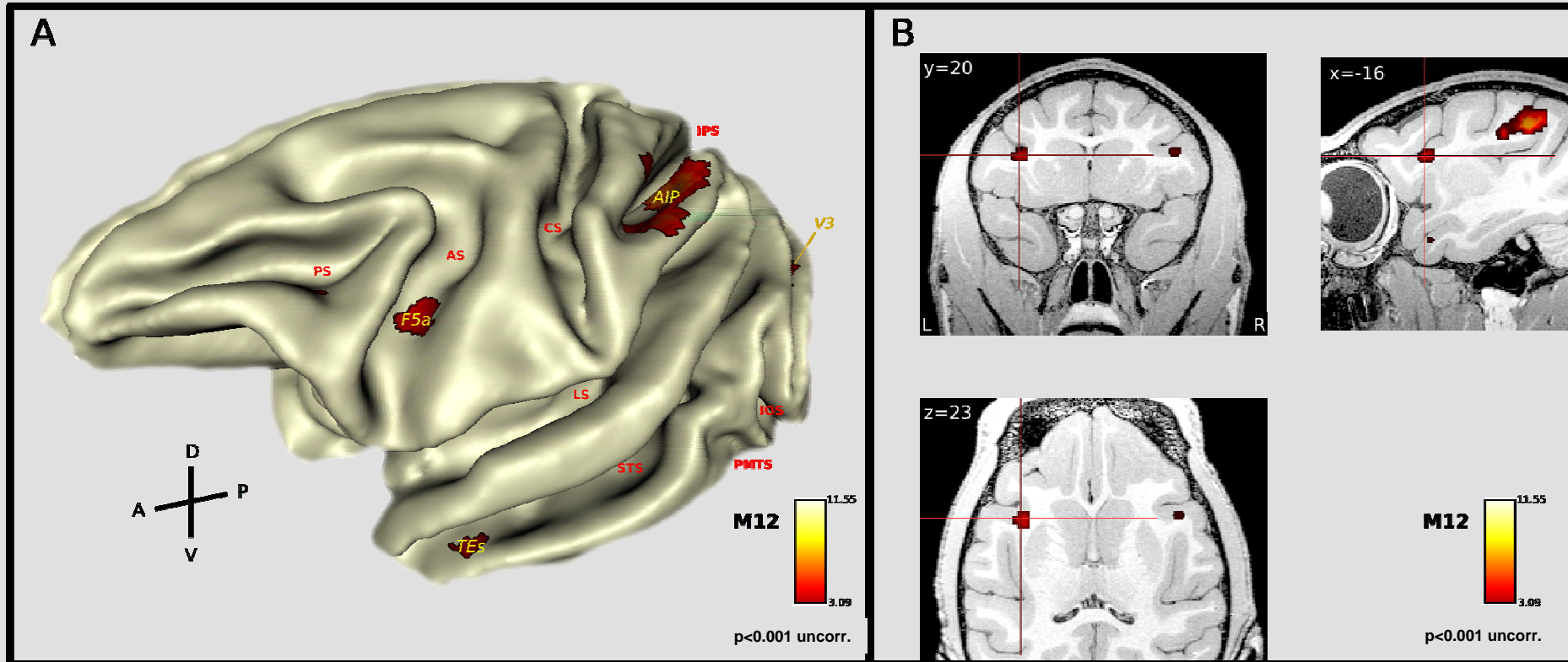
3D orientation
ordre premier



3D position
ordre zero



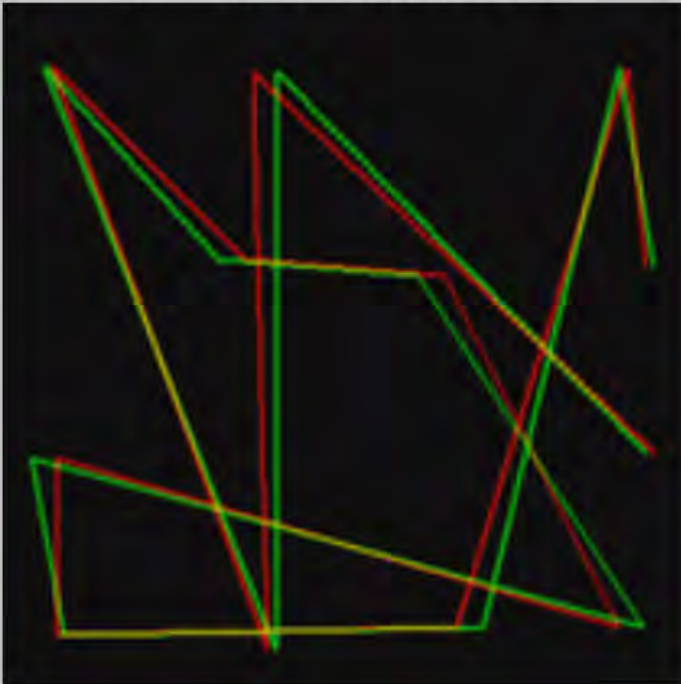
Curved stereo (- mono) > flat stereo (- mono)



STIMULI: LIGNES ALEATOIRES

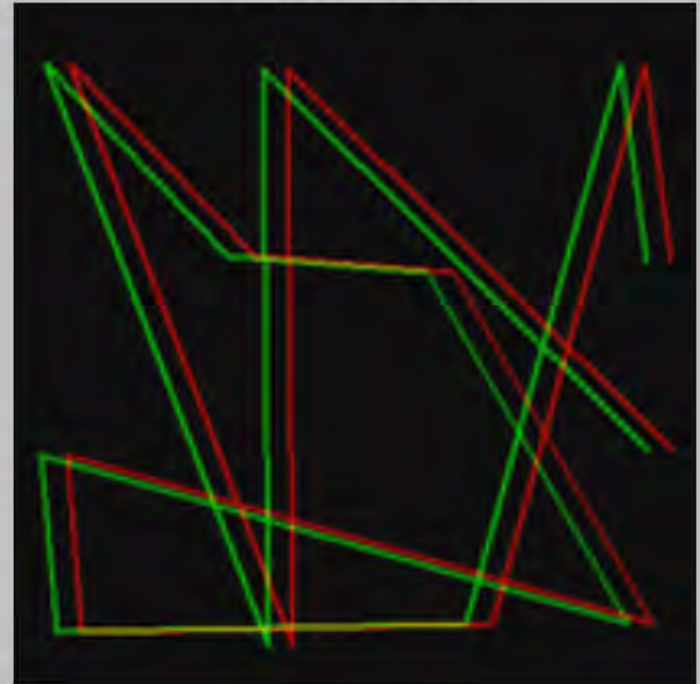
Structure en profondeur

3D structure
(2nd- and 1st-order depth)



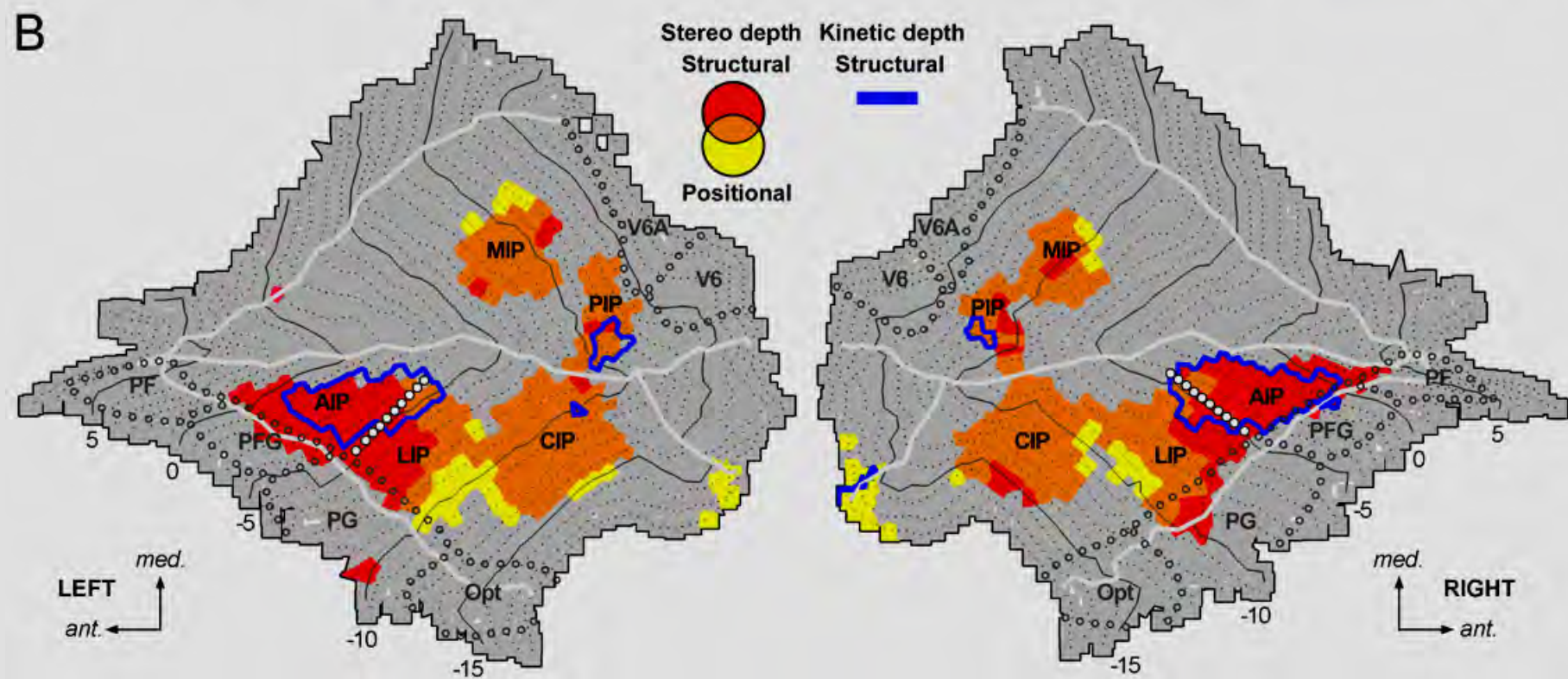
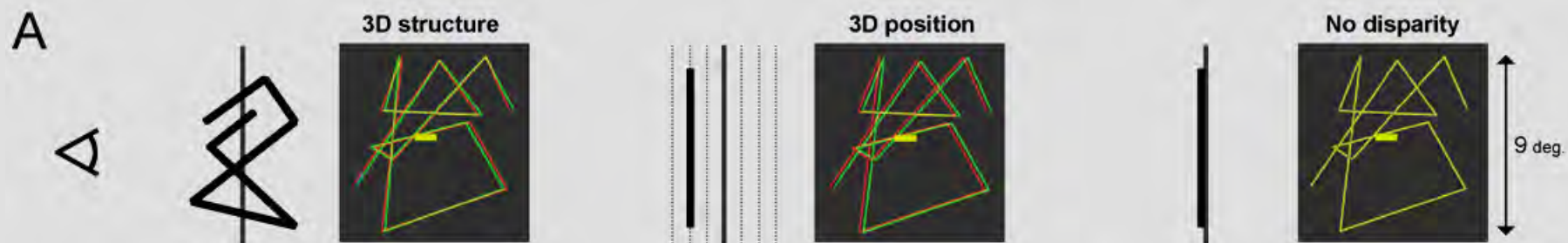
Position en profondeur

3D position
(0-order depth)

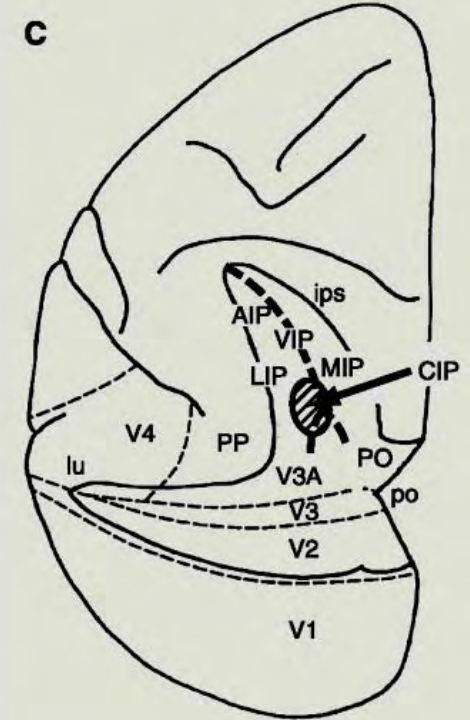
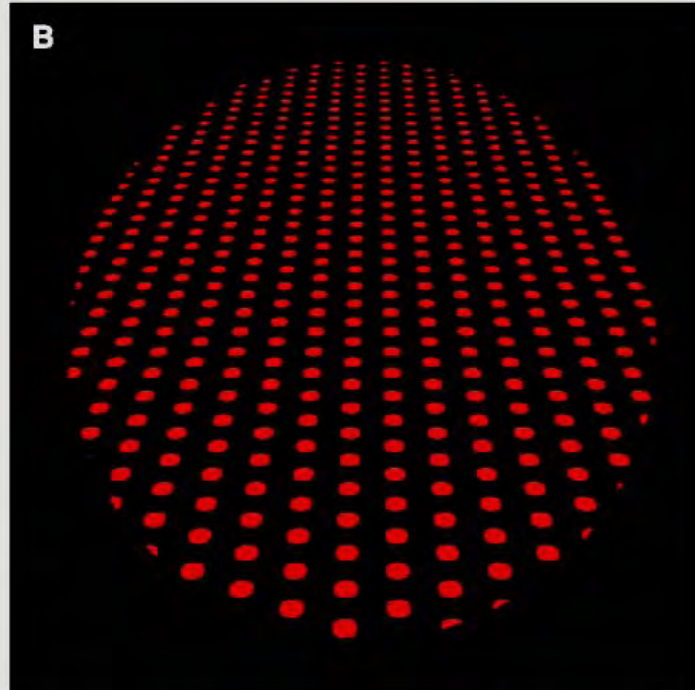
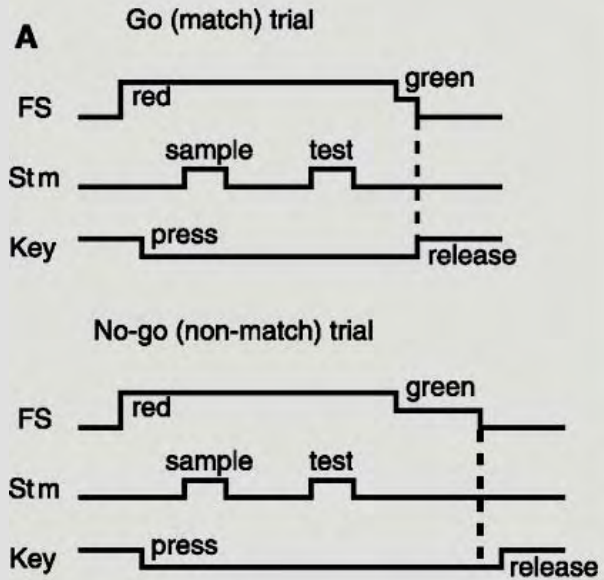


9°

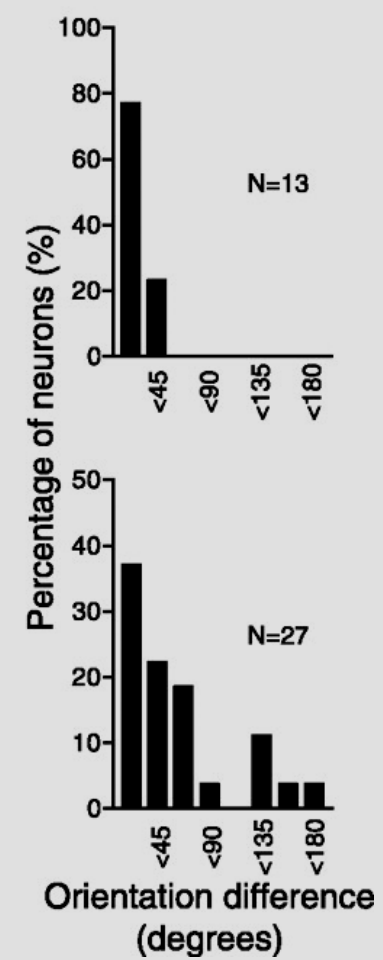
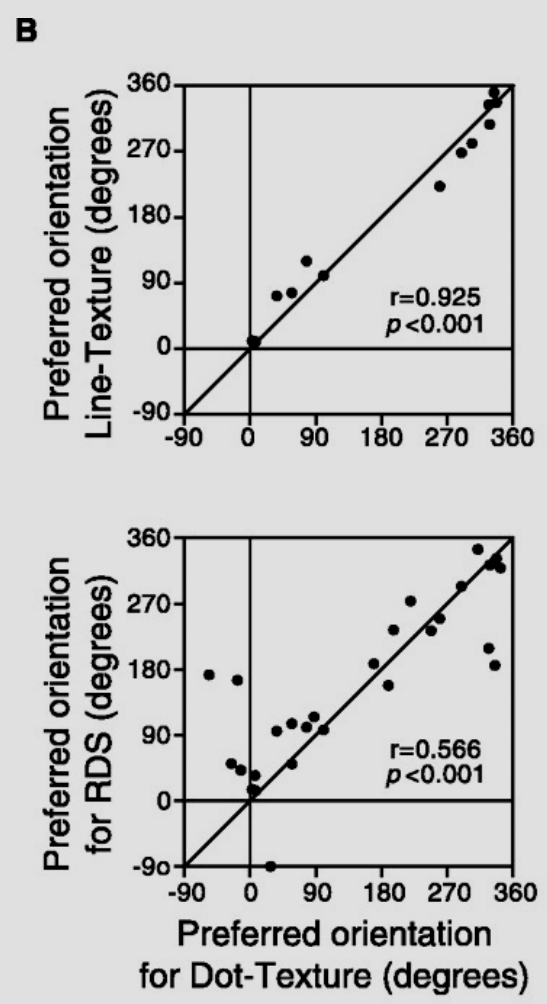
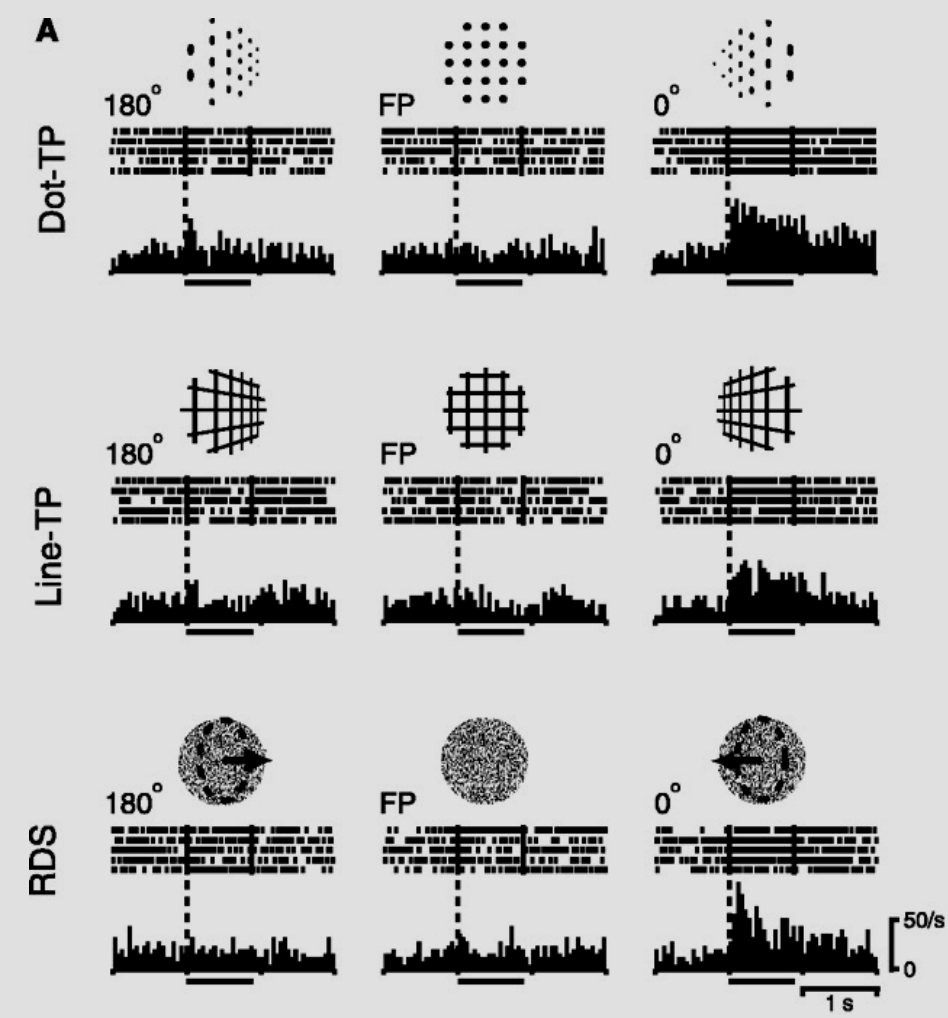
SENSIBILITE A LA COURBURE DANS L'IPS



CIP: SELECTIVITE POUR L'ORIENTATION EN PROFONDEUR.



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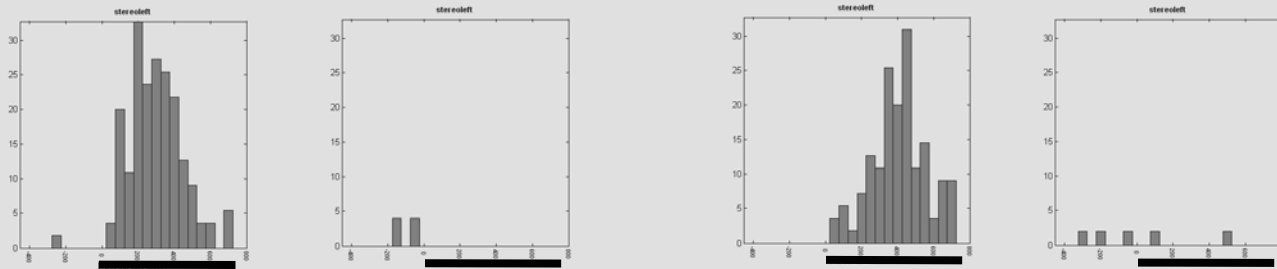
Stereo vs monocular presentations :PSTH

Cell #12

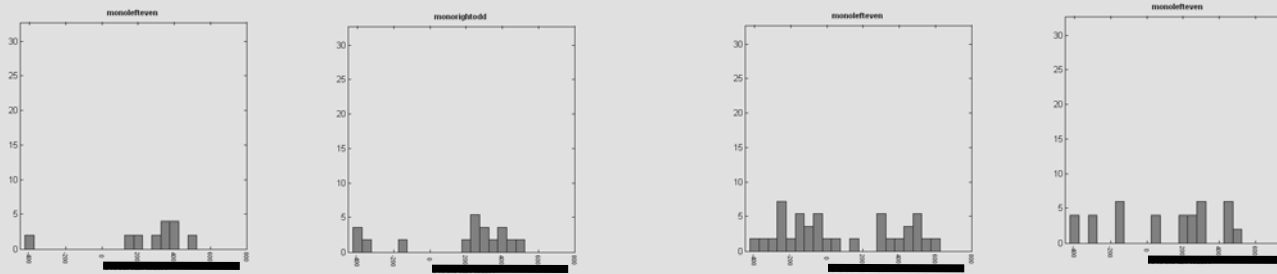
Pair 1

Pair 2

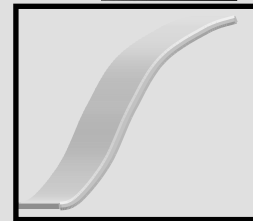
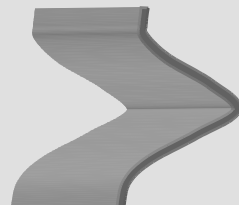
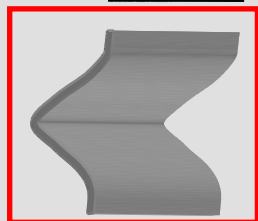
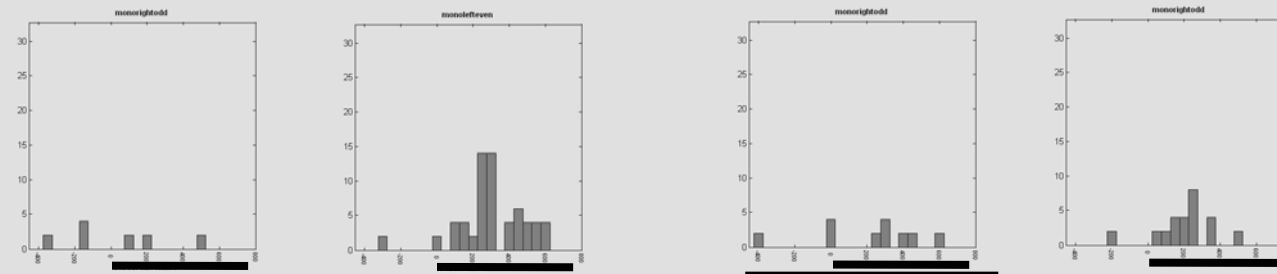
Stereo



Left eye



Right eye

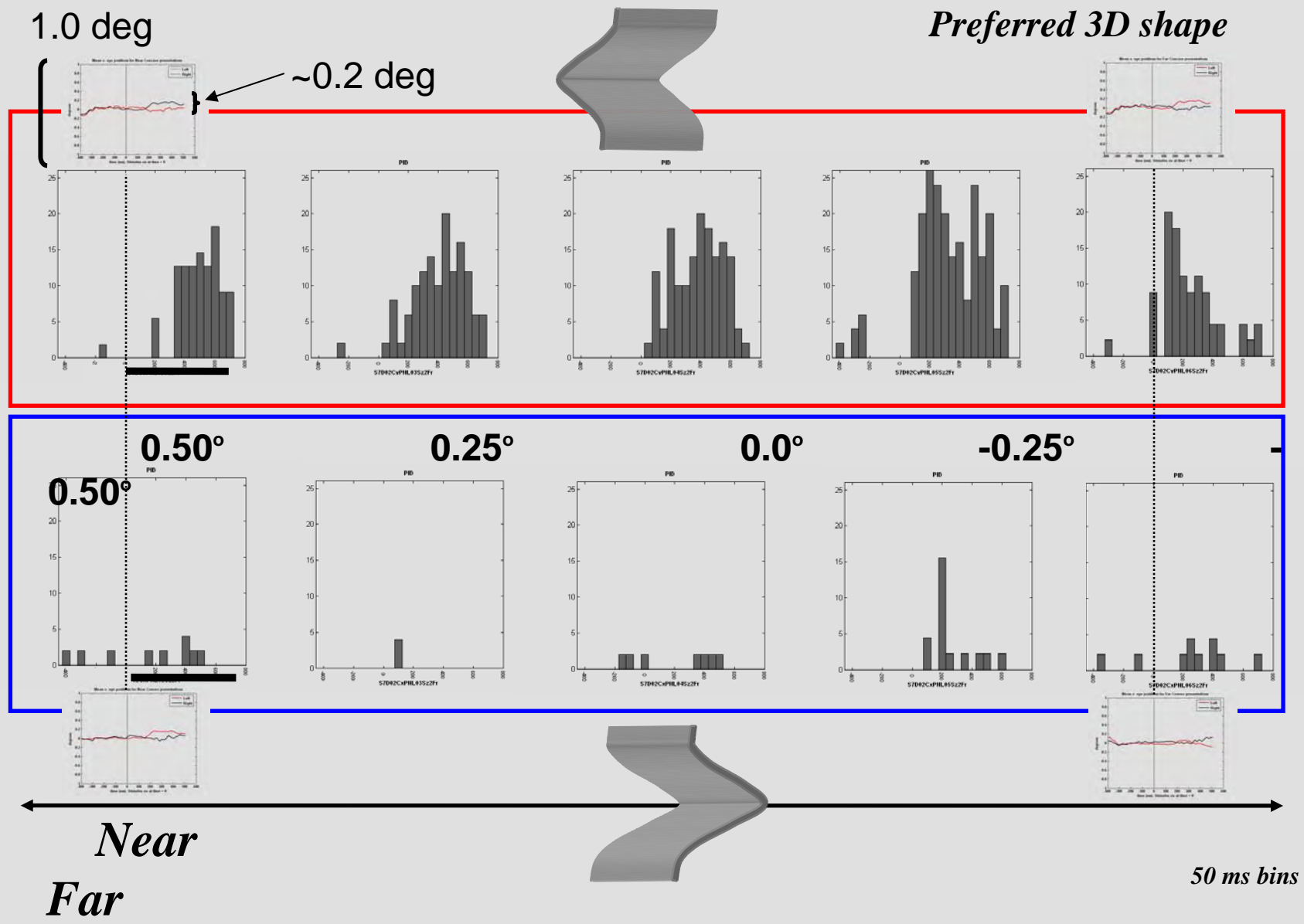


50 ms bins

NEURONES AIP: SELECTIVITE POUR LA DISPARITE D'ORDRE SUPERIEUR

Position in depth test : example cell

Cell #12



- 1) **Beaucoup de neurones sont sélectifs pour la disparité: V1, V2, V3, V3A, V4, IT, MT/V5, MSTd, LIP**
rôle dans calcul de la distance objets(information supplémentaire), reconstruction de l'espace 3D, et dans résolution des occlusions(ordre en profondeur des surfaces)
- 2) **Quelques neurones sélectifs pour l'orientation et forme 2D des discontinuités de disparités: V2, IT**
- 3) **Quatre aires sont impliquées dans traitement de la structure en profondeur (gradients de disparités)**

CIP : surfaces première ordre, grandes souvent contour simples: traitement de la structure 3D de l'environnement

trio d'aires connectées: TEs, AIP (et F5a): surfaces courbées, petites, a contour complexe: traitement de la forme 3D des objets (spéculation: description sémantique, pragmatique et réduite pour choix de l'action)

